SEPTEMBER / OCTOBER 1985

db

THE SOUND ENGINEERING MAGAZINE

Studer 961/962: Small Wonder

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FEATURES

COLUMNS

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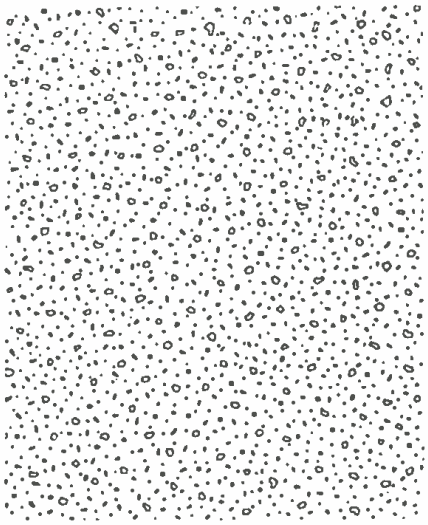
About The Cover

• This month's cover features Master Sound Astoria's control room which is featured on page 39.



Letters

TO THE EDITOR:

I read with much interest the story on the Boom Operator by Mr. King [May/June 1985]. I found it to be very interesting and helpful, as I am trying to get into TV sound engineering. I am currently working for a local TV station here in Chicago as a go-fer, but I hope to work my way up the ladder quickly. Thank you for publishing a helpful and informative magazine.

IRA LEVY

Thanks Ira... we are always happy to hear that we are of service to our readers! Best wishes from us at db *on your career in TV sound engineering!!*

TO THE EDITOR:

I have a CMD console. I am trying to find an operations/maintenance manual for the console and don't know who to contact. Can you give me the name and address of the manufacturer? I can find nothing on the outside or inside of the console giving me this information. We bought it used.

JOE COULTER

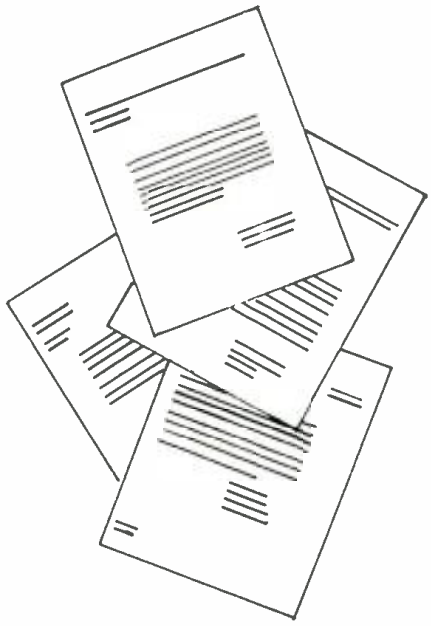
Sorry, Joe, we struck out on this one too. We checked all of our reference manuals and could find nothing on CMD. Perhaps you can give us more information; is there any other information on the console which might indicate a model number or anything else about the unit? Any idea how old it is? If anyone reading knows who makes the CMD console, please pass along the info to db *and we'll publish it.*

TO THE EDITOR:

In your May, 1984 issue you printed a report on a transducer from C-Tape Developments called the "C-ducer." I would like more information on this product and would appreciate it if you could provide an address for the manufacturer or U.S. distributor of this product.

FRED STANKE

Thanks for the inquiry. The address for C-Tape Developments in the U.S. is P.O. Box 1069, Palatine, IL 60078. There is also a toll free phone number at which the company can be reached: 1-800-562-5872.



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JOHN EARGLE

Overview of Sound Reinforcement in the Theater

• Until recent times, there was little sound reinforcement in either the legitimate theater or the musical theater. Traditionally, most of the performance venues have been small, and actors or singers were expected to be able to project their voices naturally.

In recent years, as road shows have proliferated and as performances have played in larger venues, the need for some degree of sound reinforcement has become an important one.

Pick-up techniques can vary from relatively subtle footlight microphones all the way to wireless microphones worn by the actors. In the musical theater, it has become customary to amplify the pit orchestra, although this is hardly necessary, and many a patron has complained of the often ear-splitting sound in the theater.

From the beginning of electro-acoustics, it has been quite appropriate in the theater to create some special effects electronically. Some examples here are off stage effects or voices, such as the Witch of Endor or the ghost of Hamlet's father.

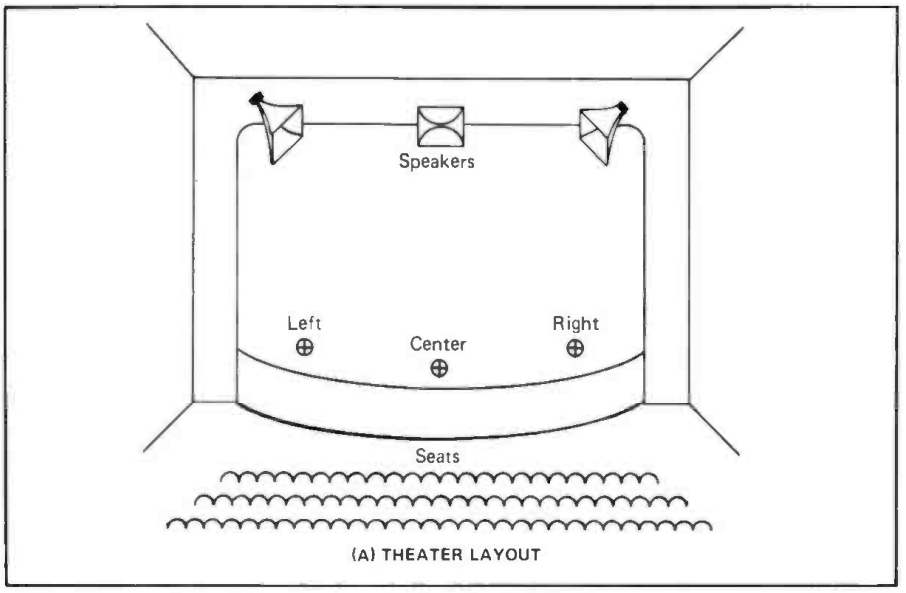

Figure 1. A simple system for theater sound reinforcement.

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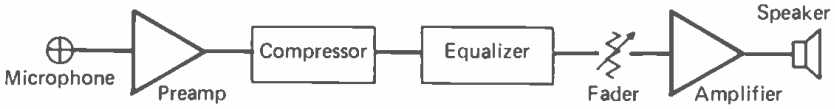

(B) ELECTRICAL DIAGRAM (ONE OF THREE)

Here, we will discuss the specific pickup techniques used in the theater and outline the requirements of large scale reinforcement and handling of special effects.

BASIC REQUIREMENTS IN LARGE HOUSES

REQUIREMENT FOR ACOUSTICAL GAIN:

In general sound reinforcement, there may be a need for considerable acoustical gain, and system layout often stresses this need. In the legitimate theater, there may not be a need for significant gain, in as much as the surroundings are relatively quiet and the actor's voices usually project well. What is needed more often than not is just a little more clarity of articulation, and this can be arrived at through subtle emphasis of high frequencies in a relatively low gain system.

FIGURE 1A shows the basic layout for a simple theater reinforcement system which requires little supervision other than basic setting of operating levels. The system is composed of three channels and as such probably will produce a very natural effect. The electrical diagram is shown at FIGURE 1B, and the typical actor-microphone relationship is shown at FIGURE 1C. Boundary type microphones are the best to use for this application.

If operation of such a system is attempted at too high a level, there will be a tendency for reverberant sound to be amplified—and this may defeat the original purpose of the system. In general, no more than 6 dB of gain should be expected of the system, and this is usually more than enough. Care must be taken that extraneous noises, such as footfalls, are not unduly emphasized. Rolling off low frequencies is common in the operation of such systems as this.

In the case of musical productions in venues seating 1500 or more patrons, the gain requirement may be considerable, and wireless microphones worn by the actors will provide all the gain necessary because of the quite small D_s distance. (D_s is the distance between the speaker and the microphone.) The drawback of these microphones, of course, is that they also pick up the rustling of clothes and other extraneous noises, and they are not always free of electrical interference effects.

STEREO VERSUS MONO:

Single-channel central array systems are the most commonly fixed installations in theaters. For speech reinforcement, they are preferable to two-channel side arrays, which are often brought into a theater for a particular road show. Most effective of all are the multi-channel overhead arrays, which are rarely installed on a temporary basis, and which are permanent features of too few houses.

MONITORING THE SYSTEM

While the system shown in FIGURE

For you, it's the sixth session of the day. For them, it's the biggest session of the year. So you push yourself and your board one more time. To find the perfect mix between four singers, 14 musicians, and at least as many opinions. To get all the music you heard on to the one thing they'll keep. The tape.

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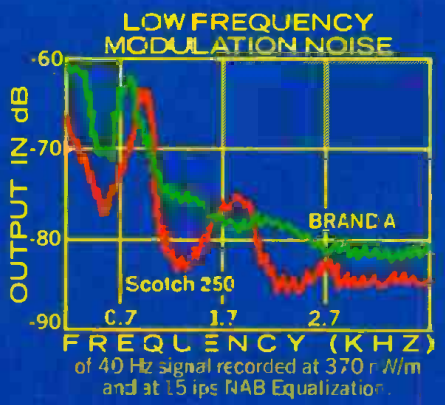

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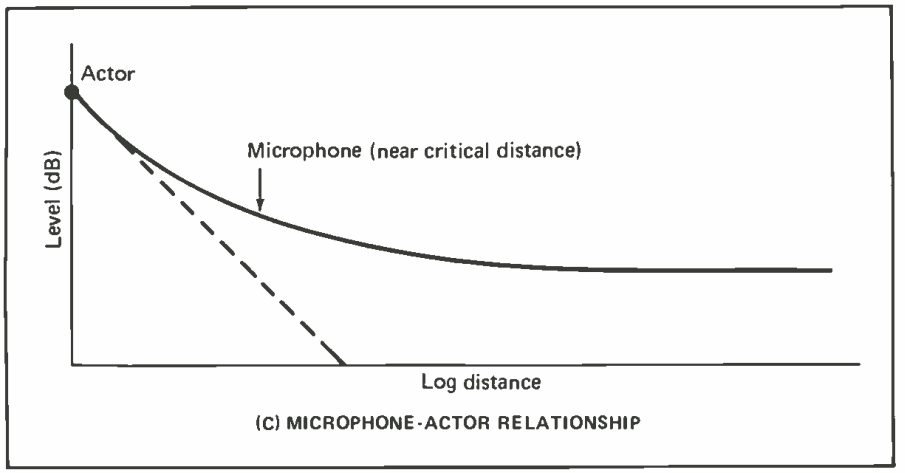


(C) MICROPHONE-ACTOR RELATIONSHIP

1 needs little or no monitoring once levels have been set, typical theater systems are more complex. The ideal position for the operator's console is mid-house, and the front center of the balcony is preferred because of excellent sight lines.

The operator monitors the actual acoustical levels in the house, and it is his responsibility to maintain an appropriate level for the program as well as sufficient feedback stability margin.

An alternative monitoring method in fixed installations is shown in FIGURE 2. Paul Veneklasen has favored this approach in many of his theater system designs.

STAGE MONITORING REQUIREMENTS:

Stage monitoring, or foldback, provides some degree of reinforced sound purely for the benefit of the performers. While few seasoned actors will require foldback, it is commonly provided for choruses and some vocalists. The benefit is a psychological one, and it often enables singers to maintain accurate pitch more easily. FIGURE 3 shows details of this.

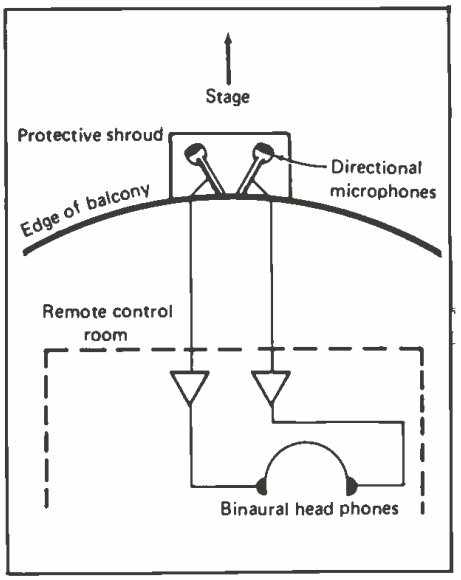


Figure 2. Remote monitoring of a reinforcement system using headphones.

SYSTEM IMPLEMENTATION:

A large comprehensive theater system will address the following requirements:

1. Inputs:
   Low level: microphones (up to thirty-two may be required)
   High level: from tape recorder or turntable; useful for background music or recorded

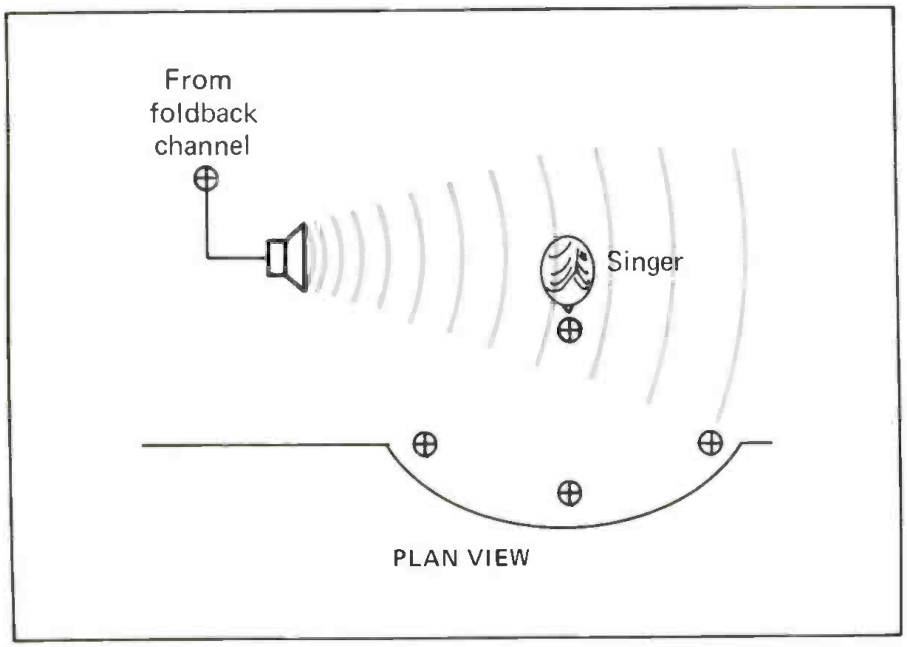


Figure 3. Foldback of reinforced signal for singers.

effects (up to eight may be required)
2. Output busses assignable to:
Recording channels (depending on application, four or more may be required)
Reinforcement channels (up to six may be required: five in central array and one delayed under-balcony channel)
Foldback channels (up to four may be required)
3. Ambience and special effects busses
Up to eight required, each capable of being fed a unique mix of delayed and reverberated sound
4. Input signal processing:
Equalization
Limiting/compression
Delay/reverberation send functions
5. Output signal processing:
Equalization
Limiting/compression
Panoramic potentiometers (pan-pots) for manual steering of signals
Delay/reverberation return functions

Above all, a comprehensive theater system will provide sufficient flexibility for reconfiguration as required by ever changing program demands. ■

BIBLIOGRAPHY

1. H. Burris-Meyer, et al., *Sound in the Theatre*, Theatre Arts Books, New York (1979).
2. J. Eargle, *The Microphone Handbook*, Elar Publications, Plainview, New York 1982).
3. Various, *Sound Reinforcement*, (compiled from the pages of the Journal of the Audio Engineering Society, New York, 1978).

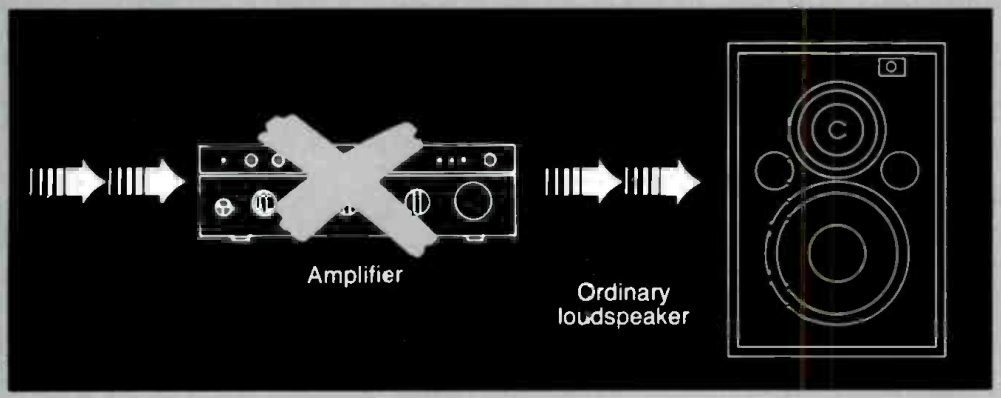
JESSE KLAPHOLZ

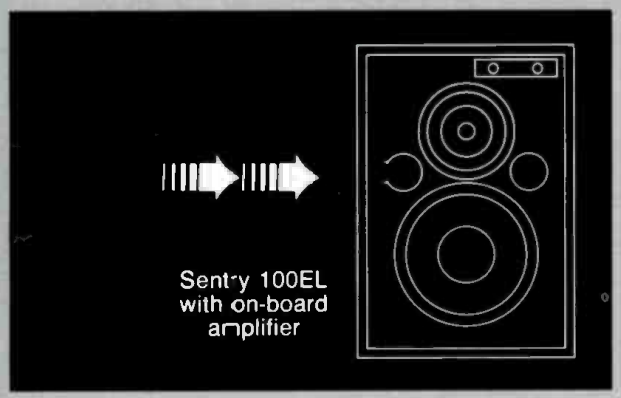
Speaker Design Software

• According to the latest Loudspeaker Manufacturer Census Report, there were 278 manufacturers of loudspeaker systems and components. These manufacturers of loudspeaker components in turn supply countless designers/builders/contractors of "finished loudspeaker systems." Given this marketplace, a software package for a popular personal computer to aid in the design of loudspeaker systems would address a large audience. We just happened to receive, for review, such a program for the Apple II series of computers—computer-aided speaker design from Scientific Design Software, Version 2.0 (CASD).

CASD is a software package that allows one to quickly and efficiently perform various documented calculations for the loudspeaker design process. This software is the product of a group of loudspeaker engineers who found it necessary to write their own program to help them in their daily design tasks. Therefore, the program is comprehensive and easy to use *vis a vis* its menus and the manual's explanations. CASD affords insights during the design process as well as speeding up design time.

The program comes in a two-sided-disk format along with a second disk





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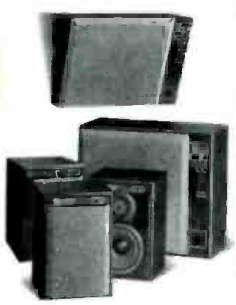

With speaker and amplifier in one compact, rack-mountable package, this monitor system solves problems like limited rack space, equipment transport on remotes or cramped spaces in video editing booths.

Also, by requiring less hardware—fewer cables and connectors—the 100EL keeps setup simple and reduces potential interconnect problems. And there's no possibility of power loss caused by resistance from a lengthy speaker cable.

The on-board amplifier in the 100EL makes it ideal for single-channel monitoring. Why buy one speaker and an extra amplifier channel, when the Sentry 100EL does the job all by itself? And because amplifier power is perfectly matched to the speaker system, there's no chance of damage from inadvertent signal overload.

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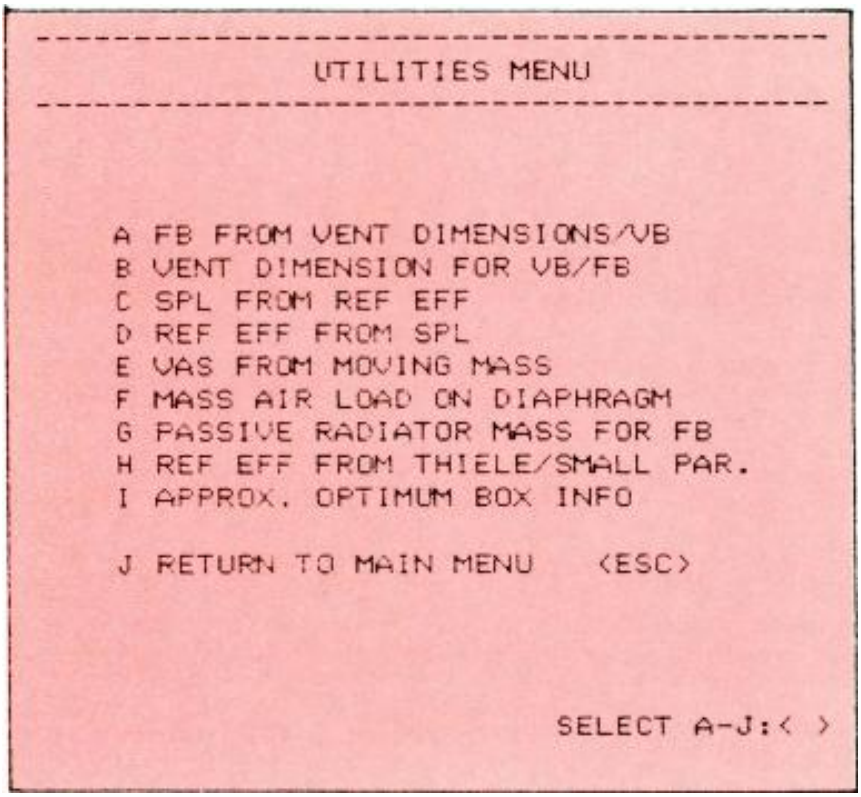

Figure 1. Utilities menu.

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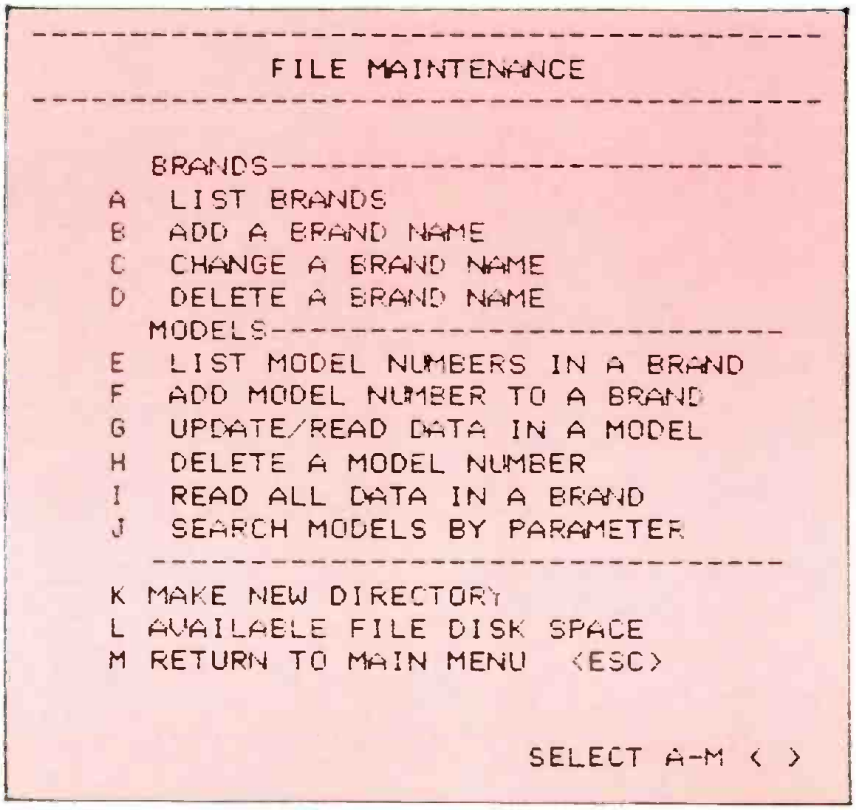


Figure 2. File Maintenance menu.

which is a file-disk of twenty-four loudspeaker brands with about 120 models and their associated parameters. Boot-up and subsequent disk access is rapid, thanks to the use of Apple's PRODOS disk operating system. The owner's manual is a good example of how engineering software manuals should be written. Aside from explaining how to use the software, the manual aids the designer with explanations of design techniques, loudspeaker and system parameter definitions, helpful design hints and tips, a listing of APPLESOFT and PRODOS error codes (along with what they mean), and printer/interface instructions. The manual also contains a section on sealed and vented design theory, discussing the relevant aspects of modelling theory, efficiency bandwidth product, enclosure parameters, vents and passive radiators, response and displacement limited curves, B4 and B6 system relationships, and filter parameters.

Upon booting up of the program, the MAIN MENU-SIDE ONE prompts the user with a choice of SEALED SYSTEM GRAPHING, VENTED SYSTEM GRAPHING, UTILITIES, FILE MAINTENANCE MODULES, or the user

may go to side-two. MAIN MENU-SIDE TWO contains a crossover design module which, if so desired, can be run independently. The two sides have been segregated in this way to allow for future enhancements and expansion of the crossover design section.

The SEALED SYSTEM GRAPHING and VENTED SYSTEM GRAPHING modules are identical in operation. These program segments do not display standard menus —instead, a choice of one of three different dynamic range blank graphs is displayed. The user then has a choice between entering the pertinent data, either manually, or from an existing file from disk. Entering driver information is easily accomplished via "smart" screen prompting.

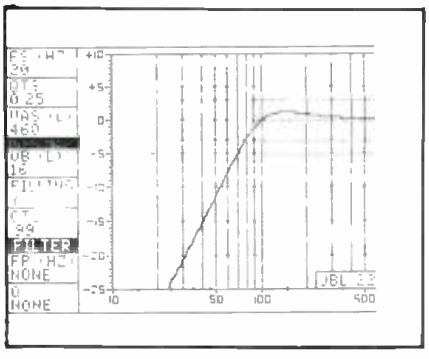


Figure 3. Example of a sealed system graph.

Next, the program asks if you wish to use an auxiliary boost filter. The resultant graph may now be printed. After the printer routine, the program will prompt you to see if you want a displacement limited power curve. After the displacement graph, one may either return to the main menu or continue analysis. If a displacement plot was not done, a new plot may be computed or even superimposed on the previous plot, yielding "stacked" plots for convenient comparisons.

The CROSSOVER DESIGN MENU allows one to design one of five types of crossover networks or proceed to the IMPEDANCE CORRECTION MENU. After selecting this menu, one may design one of three types of correction networks: resonance or Zobel network, high-frequency rising impedance correction by driver inductance network, or high-frequency impedance correction by driver impedance curve network. Each section allows for reiterative calculations with the option of exiting back to the menu at any time.

The programs are practically "bomb-proof," in that they do not allow for "illegal quantities" to be entered. The manual contains an easy to follow tutorial on this section.

The UTILITIES PROGRAMS are a group of quick routines which are useful for solving a number of simple, and often frequently used formulae. The UTILITIES MENU is shown in FIGURE 1. This section is set up in the same manner as the crossover section. Noteworthy here is the APPROXIMATE BOX DESIGN information utility. This utility is very useful as a starting point for a system design

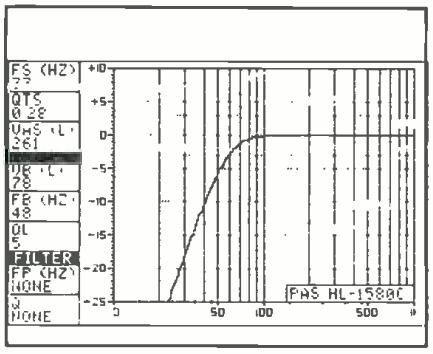


Figure 4. Example of a vented system graph.

with a given driver. After entering the input parameters which define the driver, the utilities calculates:

The box volume for the flattest vented system with the box tuning frequency (F_B) and the -3B cutoff frequency (F_3).

The box volume for the B6 assisted alignment with the box tuning frequency (F_B), the -3 dB cutoff frequency (F_3) and the filter peak boost frequency (F_P).

The box volume for the flattest unfilled sealed system with the -3 dB cutoff frequency (F_3).

With this information, one gains immediate insight into the suitability of a given driver for various enclosure designs.

After selecting FILE MAINTENANCE from the main menu, the display shown in FIGURE 2 will come up on the screen. This set of utilities is comprehensive and easy to use. As with the other utilities, every function is completely explained in the manual. Even though PRODOS is known for its "user friendliness," CASD has eliminated some of the file name restrictions in its utilities. As an extra bonus, there is a database-like feature in this utility, which allows one to search for a model loudspeaker with up to three given parameters. The CASD manual concludes with references which are the "standards" of the literature in loudspeaker system design.

The CASD program was found to be a delight to use. It was easy to learn, and could not be "latched up." The graphs are excellent, and likewise all the graphics are laid out clearly and are easily read, even from a distance. As was mentioned earlier, disk access is quick, allowing to move from one section to another rapidly. All in all, the computer-aided speaker design program should find a happy home in every loudspeaker engineer's Apple. ■

BARRY BLESSER

Living with Standards

• Every profession tends to have its occupational disease with unique symptoms. The engineer generally displays a mystical belief in the underlying rationality of life. Even if he cannot know or create the full rational explanation, he tends to believe that it must exist. Certainly this series on digital audio has been one of formal reasoning to demonstrate phenomena and explanation. The audio engineer does, however, display a greater tolerance to other issues, at least compared to "pure" engineers because he must deal with the issue of perception. In our attempt to understand the meaning of digital audio, we had recently considered the issue of economics in the manufacturing context of digital audio equipment. Now we will turn to another topic: the impact of standards. This area covers many different disciplines including the law. While most of us have little contact with lawyers and the practice of law, except perhaps in buying a house or getting a divorce, we underestimate its impact on our professional life. Let us consider this impact in general, and in the specific context of digital audio.

DEFINITION

Before we begin, let us first consider the semantic use of this word in different contexts. Because the word belongs in everyday discourse, a dictionary will have a large number of definitions. My simple dictionary has nine distinct meanings. The one which we are interested in is the following: "something

established by authority, custom, or general consent as a model or example." The incompleteness of this definition comes from the lack of specificity in the words "authority, custom or general consent."

Who does the defining process? In the loosest sense of standard, we may articulate a statement of the form: it is standard for manufacturers of audio amplifiers to present the measure of non-linearity in terms of harmonic distortion. This simply says that most companies do it. Any given company might not and there is no implication of either doing or not doing it. Similarly, we could say that it is standard for audio technicians to use 60/40 solder. This informal use of the word "standard" is not particularly interesting to us even though it is the most common use of the word.

The more important aspect of the word is when we read that the quad driver 26LS31 satisfies all of the specifications and requirements to satisfy the RS-422 standard. This standard is a formal document which lists characteristics of a certain communications technology. Any manufacturer may make any kind of buss driver, but only those which are one hundred percent consistent with the standard document may be a standard part with that technology. This leads us to several interesting questions. How do these standards come about; and how does the existence of the standard influence our technical activities?

STANDARDS AS SIMPLICITY

Few of us realize the degree to which standards make our life more or less simple. The fact that any TV can be connected to any antenna is a result of the use of a 300 ohm standard. Any standard long playing record can be played on any turntable because they all use the same standard for groove size, modulation type, pre-emphasis, etc. Automobile tires are standardized for interchangeability. The meaning of two-compliment arithmatic has a standard meaning so that we can communicate with a two word phrase instead of a formal paragraph. The power mains plug on every piece of American equipment is standardized so that we do not need unique adapters in different locations. The layout of the keys on a typewriter is standardized so that a typist can type on any keyboard without relearning.

Standards permeate our life to a degree which would surprise most of us. There are other parts of the world where there are not as many standards. In some countries, there may be many different kinds of power plugs or even power voltages. The lack of a universal standard prevents moving equipment from one location to another. Imagine a world in which each manufacturer had his own different screw standards. Imagine a world in which the key layout of each typewriter or computer were unique. Or consider a world in which each tape recorder manufacturer had his own track format.

A world with insufficient standards is an extremely complex and problematic one. To appreciate the size of the problem try talking with an international company which makes consumer electronic equipment. There are at least twenty different safety standards. Generally, there will be a full time engineer having the job of trying to evaluate a design satisfying all such standards. It is a more than non-trivial task. Life becomes still more interesting if some of these standards are in conflict; we then need different versions of the same equipment. One country may demand only yellow headlights, another requires sealed beam white, and still another requires replaceable bulbs. The US is currently trying to force the introduction of metric standards to be consistent with the dominant part of world technology just for this reason.

The simplicity and peace of mind that comes from universal standards suggests that we should try to create such standards whenever possible. Unfortunately, there is another side to these standards which is often negative.

STANDARDS AS ANTI-PROGRESS

Once a standard comes into popular use, it is extremely difficult to make improvements. The best example of this is the US TV standard for color pictures. This NTSC standard specifies a format which is difficult and problematic and it does not compare favorably to the German DIN standard for PAL. This standard was developed after the US standard and the German TV engineers designed a system which did not have many of the defects of the US system. Yet, no manufacturer could introduce these improvements in the US market since that would not allow that TV to receive any programs in this country. The standard freezes technology at the level of the time of creation.

Many communities have a building standard which requires copper pipe even if the corresponding plastic pipe was just as good and cheaper. Manufacturers of plastic pipe are excluded from many markets and the consumer must pay more for the same result. This produces a competitive monopolistic advantage for one industry over another. In some few examples, there are standards which force the use of a privately owned patent. To sell a hi-fi receiver which contains the ability to decode Dolby records and tapes, that manufacturer must pay a royalty. It is not true that the decoding ability requires the use of patented technology, but there may be few economic implementations which are not patented. Patents cover implementations. Realistically, however, some patents are good enough to effectively force a royalty payment.

We can thus see that standards may inhibit technological progress since they are based on a technology at a given moment and they may not be improvable. Standards can also advance the economic vitality of one company or industry while hurting others. Because of these potentially serious negative attributes, countries pass laws regarding the use of standards. In the US, standards activities are often subject to the same anti-trust, anti-monopoly laws as other activities. Each country has its own definition of the legal standards activities. What is legal in one country may be illegal in another. Notice that it is the people that are subject of these laws not the resulting standard. Do not forget that standards are more like definitions than laws.

This discussion on standards is particularly relevant to digital audio because such standards are just now being developed. We have an opportunity to look at the process and to consider the meaning to this new industry. We will now look at this process.

IDEALIZED STANDARDS

In the most ideal world, standards would be the result of a technology which had been evaluated by all members of the community including both manufacturers and consumers. All possible technologies would be evaluated by initially having no standards. Each manufacturer would invent his best system

and each consumer would evaluate all of the choices for his particular need. With so many people inventing and so many people evaluating, it is likely that a clever technical idea would not be discovered and then appreciated. After this sorting process had gone on for some time, the better ideas would be economically supported by the consumers and other manufacturers would then imitate them. In theory, the best ideas would dominate and the worst would drop anyway.

In some situations, multiple approaches might result where there would be different groups of consumers. The professional might be willing to use a higher tape speed for better signal-to-noise ratio even if that meant using more tape; while the home consumer might be more interested in getting more program on a given length of tape than a few more dB of noise suppression. This would result in two sets of approaches for two different markets.

After many years, it would become clear that there were only one or two sets of characteristics being used. A group of people could then work together to define those attributes which the market had selected. This list of attributes, after suitable review, would then become a standard. The mechanics of creating a standard are legally very complex. There are recognized standards organizations, which have policies and procedures governing the mechanics of standard creation. Lawyers would have carefully examined them to insure that they were fully consistent with the laws. For example, there are groups such as the ISO (International Standards Organization), IEC, ANSI, etc. Each of these has working technical committees which formulate proposals after taking input from the open public. Interested parties are welcome to attend and supply input.

NON-IDEAL STANDARDS

Countries other than the US have more liberal laws regarding the creation of standards. In these countries, a group of manufacturers can gather together in closed rooms to work out a standard before any equipment has ever been built or tested. Companies with more economic and political power can sometimes force their ideas on the other members. Even without this kind of pressure, a company can have such a large share of the market that it can simply become the standard without sitting down with anybody.

When a standard is created in this way, the attributes have not been fully tested or evaluated. Nevertheless, the attraction is so great that this can be the method used in many cases.

There are some interesting examples of these approaches in digital audio. The early professional digital tape recorders did not have any standard with regard to either format or sampling frequency. It was difficult for manufacturers to sell such equipment because the potential buyers had to invest a large amount of money in equipment which might prove to be very obsolete when a standard would come into existence. Moreover, the tape made on such machines would not be portable to other studios which used other types of equipment. As a result, professional digital audio tape recorders took a long time to enter the market and many companies and consumers lost a large amount of value on machines which were not popular.

This is in contrast to the introduction of the consumer CD player which was developed by companies outside the US. They did create a standard before the introduction of any machine. There was never more than one choice for the consumer. Clearly, the lack of a market test had an advantage for those manufacturers who participated in this standard creating process.

Had this been a US group of manufacturers, many of them would probably have been in jail. This is one of the ironies of international business. On the other hand, there is some evidence that the CD standard is not ideal. Some engineers have demonstrated other error correcting methods which appear to have some advantages. The bit density of the format is so high that the encoding process is extremely complex, requires expensive equipment, and often results in low yields. If one was very cynical, one might imagine that some of these decisions were not accidents, but attempts to limit the market to companies with high technology staffs, large capital bases, and those who were part of the "inner" circle. International business is not played with the ideal rules of US anti-trust law.

Who are the winners and losers? That's hard to say. The CD technology is certainly impressive and the consumer cost has been dropping extremely rapidly. That is obviously a positive. On the other hand, the technology is more restrictive and the number of small players is almost non-existent. Will the situation in professional audio be the same? Perhaps yes, perhaps no. The speed of equipment introduction is restricted by the cost difference. A $250 CD player is a different animal than a $200,000 all digital recording facility or a $5,000,000 record encoding plant. If one is even more cynical, one might imagine that the introduction of the consumer CD is a mechanism to force the introduction of professional digital audio even if those players had wished to wait.

Notice that these kinds of issues are only partially a matter of technology. It is not the engineer that drives this class of issue, but the business and legal community. We should not think that because we invent the digital audio technology we will control and dominate it. The mother may give birth to the baby, but the teenager has a life and mind of its own. Parenting changes when the child grows up. Digital audio is now a teenager, having been around for fourteen years! ■

IAN EALES

Have Wire Will Travel

What does a 'straight wire with gain' sound like? Does a passive component sound all that much different from an active one? Read on for the answer to these questions and many others.

YOU WOULDN'T THINK a piece of wire could change the way music is recorded. Until about one year ago I wouldn't have thought so either. But it can. Today at Garden Rake [Studios], Jay Graydon and I, chain process devices together with short pieces of Monster Cable instead of running everything through the patch bay. Although this is more inconvenient, sonically, one would lose too much doing it any other way. When making tape copies, the two machines are connected with short cables that just reach from one machine to the other. The difference is not to be believed. The bottom end remains much more defined without getting muddied up like it would when using conventional cable run through the patch bay. When recording synths or drum machines their output is fed directly into any processor and then directly into the tape machine. The attack is much more defined and the harmonic structure is much richer.

"Maybe it does sound a little better, but really, it's a lot of bother," you say. Then perhaps you don't really care about your records sound and would do just as well selling shoes. If you do care about how your records sound then I hope you will find something useful in these words. You will see that the simplest things can make the biggest changes in the quality of the recorded sound.

As an audiophile I had always been appalled at the sonic quality of some of the equipment we use in actually making the recordings. It was funny that audiophiles spent $2000 on a discrete transistor or tube phono preamp when the signal had been recorded through a chain of about twenty-five op amps per channel costing about sixty-nine cents apiece. When wiring a studio, I always cringe at the thought of what the wire being used is doing to the signal. For about twelve years now I have been one of the lunatics who think they can hear the difference between different makes of components, and even more incredibly, interconnecting wire. Of course this is not possible, as any "scientific meter reader" (SMR) will tell you. If any difference can be heard, the SMRs say, it is because of a failing in the design of the circuit. OK then, if a wire sounds better with every application it is used in, including the circuits designed by the SMRs, does that mean all circuits have design faults that make them unstable with conventional wire? I think not. Even the most simple minded look at that logic gives us two choices: 1) all amplifiers are unstable, or 2) some wire sounds better than others. The rest of this article, as you may have guessed, takes choice number two as the more intelligent of the two.

Ian Eales is a recording engineer and an electronic designer who built and maintains Garden Rake Studios.

CHOICE NUMBER TWO

At home I always use what I feel is the best interconnect available. Over the years it has been Polk Cobra Cable, Oracle Cable, Mitch Cotter, Mark Levinson and a lot of others that were eminently forgettable. About two years ago I started using Monster Cable Interlink Reference in my home system. The difference was nothing short of

Ian Eales ready to go with his Monster Cable.

incredible. For the first time I felt transients were in time with the rest of the wave form. For the first time the bottom end didn't sound like it was being homogenized by the rest of the signal. The mid range had a power I had previously thought not possible from recorded music. The highs were open and airy. It was a brand new experience. And much cheaper than another fifteen grand for a whole new system. About a year later, in May 1984, I saw a Monster Cable display at AES in Anaheim and asked what they had for the pro market. I bought a few different cables to try at Garden Rake in controlled tests in the studio. Lo and behold the same improvements I heard at home were just as apparent in the studio. In blind tests I would record a musician or vocalist used to working at Garden Rake and see if they noticed their sound had changed or improved. More often than not they asked what I had done to make it "more open" or "more punchy" or "more musical." Once in the middle of a tracking date, I changed the wire on Nathan East's bass, while he was out of the studio. When he sat back down and started playing he looked down at his bass to see if something had changed. When I asked him what the matter was he said nothing was wrong, but his bass sounded "bigger, more defined and a lot more powerful." Must have been the direct box overloading. Couldn't have been the wire.

Jay's (Graydon, owner of Garden Rake) favorite limiter is the one made by George Massenberg. He likes it so much we have two of them. When I installed the second one I used a different type of wire than was used on the first one we had. After it was in, Jay said to me, "You know that second limiter doesn't sound as good as the old one." "Different wire," I said. "Better change it," he said. Even I was amazed at how much less the limiter colored the sound after it was wired with Monster Cable. With George Massenberg's equalizer and Monster Cable, all Jay can say is, "Man, it's so BIG." When Robbie Buchanan first heard me talk about the wire making a difference he thought this time I had really lost it. When I changed his entire synth system to the cable, all he could say was, "Unbelievable."

A PASSIVE DIFFERENCE

Even though I've been raving about the difference Monster Cable makes, it has only been as a way of introducing the main topic, and that topic is 'passive components in the recording chain make as much or more difference to the sound than do the active ones.' In all of the examples given so far, only passive, or what we think are passive devices, have been changed. But in every case there has been a dramatic improvement in the quality of the sound. It was only after using a different cable in the studio for a while that I changed my focus in trying to improve the sound at Garden Rake from active to passive devices. All that is required with the passive avenue is to use shorter cables, remove superfluous switches and pots from audio circuits, and not use all the fancy routing of SSLs and Neves.

IDENTIFIABLE DIFFERENCES

While mixing *High Crime* for Al Jarreau with Michael Verdick at his studio, Channel Recorders, I showed him the difference cable could make to the sound going to the 2-track. Lest you think only a select few can tell what kind of difference these kinds of changes make, read on. While at the CES convention in Chicago this year the topic of my work came up and we were talking about the *High Crime* LP. Two separate people on two separate occasions asked what was wrong with the cut. "After All." They add, "The track sounded muddy and the vocals sounded recessed compared to the rest of the album." Wouldn't you know it, "After All" was the only track on the LP not mixed using Monster Cable to go from the buss to the 2-track. I had purposefully done this to see if what I was hearing in the studio could make it all the way through the process to vinyl. Neither of these people could have in any way known about this in advance as I only met them for the first time at CES.

Michael Verdick became convinced good wire made more of a difference to the sound in his studio than reworking his Trident TSM and installing new op amps. He recently shortened the wire from the 24-track by about 12-feet and bypassed the monitor section on his console by putting patch plugs on the console end of each

Ian Eales at Garden Rake Studios' console.

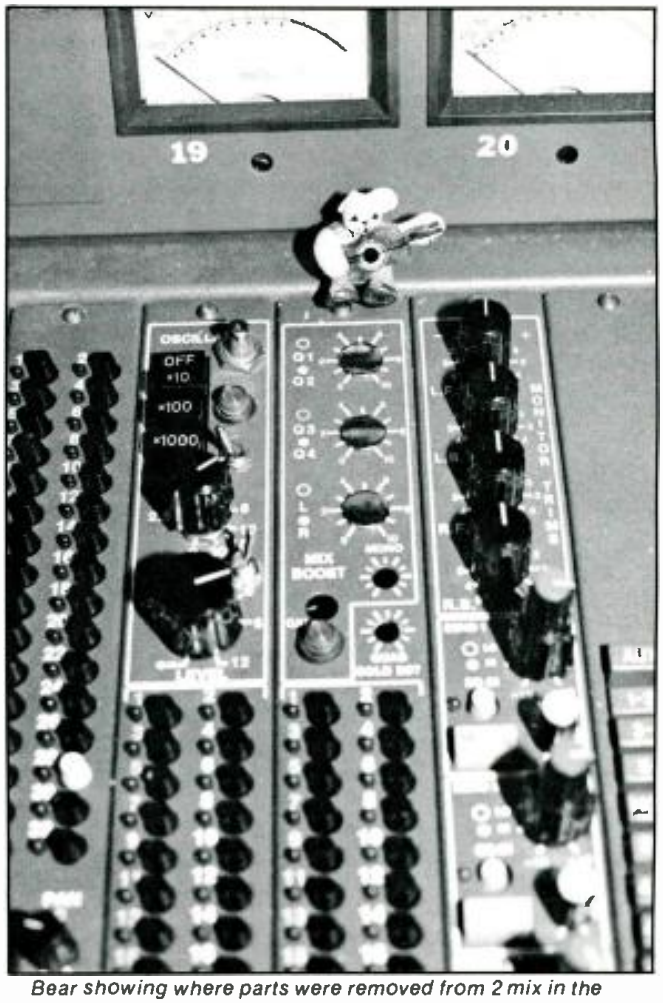
of the 24-track wires and patching directly into the line-in section of the console. The difference was *astounding*!!! You would swear we had removed a limiter and an equalizer from the buss. The sound was more dynamic, more defined, more open, and lastly, and most importantly, more musical.

SEE FOR YOURSELF

Now, none of this is ground breaking new technology. Years ago Doug Sax was telling us silver switches sounded better than gold. All I'm saying is no switch at all sounds better than any switch and no pot sounds better than any pot. If any of you are skeptical of this, try this simple test. Take a 10k volume pot and wire it up so you can use it for an insert in the monitor section. When cutting the wire for the pot make it as short as possible and cut two extra lengths *exactly* the same length to be used later. After you find the most comfortable setting on the pot for listening, take some five minute epoxy and glue the shaft in position. Set it aside and really let the epoxy harden for at least an hour. When it is good and hard take an accurate digital voltmeter (here's where digital stuff really shines, taking accurate *static* measurements), and measure the voltage divider ratio of the pot for each channel. Be very accurate so the SMRs can't fault your methodology. Now get some good metal film resistors with one percent tolerance and make up a voltage divider with the same ratio as the pot for each channel. Clip the leads on the resistors as short as practical as this is just low grade solid wire and we

wouldn't want it to upset the amplifiers. Now we have two very closely matched fixed volume controls. Now for the fun part. Set up a mix as you normally would with the fixed pot as your main level control. Unless you are deaf or your setup is totally beyond help I think you will find the resistor network is more dynamic, more detailed, airier and *more musical.* Again this is nothing new.

All I am trying to point out is features have taken over at the expense of the audio. We really need to question whether the technology is taking over and depriving our audience of musical enjoyment. Just about the time the record industry started its decline was after everybody and his dog had gotten into the studio business. This may seem a little far fetched but perhaps after years of listening to records made on old simple consoles people didn't like the new sounds coming from the new studios and the new generation of equipment and therefore they lost interest in buying records. This was at the same time when consumer hi-fi was at its highest growth period in its history and much better reproduction could be had for much less money. If you think this is all a little too far fetched go and listen to an old Elvis (Presley, not Costello) recording made thirty years ago on 15 ips analog tape. In terms of *musicality* it blows the doors off most anything made today. Is [Pink Floyd's] *Dark Side of the Moon* still on the charts today only because of the songs? No, it is still there because it is a *musically* satisfying recording. A game we often play in the music business is 'Beat the Demo.' A song is demoed in a small, simple studio and when we re-record it in one of the advanced rooms it often just does not measure up to the excitement of the demo. Has all the high powered technology gotten in the way and reduced the *music* of the song to mere *sound*? This reminds me of that old cigarette commercial that asked "Are you smoking more and enjoying it less?"



Bear showing where parts were removed from 2 mix in the console.

CONSOLE CONDITIONS

This next bit isn't really going to win me a lot of friends in the console business, but here goes anyway. For all you hard-pressed studio owners thinking of buying a new console or (yuck) digital machine in order to compete in today's market, perhaps you could look at making changes to your existing equipment that would improve the product coming out of your facility more than any new console. A few examples of studios that have old gear and good sound are Alan Sides Oceanway, Doug Sax's Mastering Lab, Producers Workshop and Michael Verdick's Channel Recorders. This is not to say these studios couldn't be better because they could. A recent example of how graphic a difference these kinds of changes can make, is a project that was half recorded and mixed at one studio on a Trident TSM and the other half done, by the same engineer, at Channel Recorders, also on a TSM. When it came time to master the project, the mastering engineer could not believe the difference in the two studios. He said the product from Channel was (here we go again!) more dynamic, more detailed, airier and more *musical.* This was a completely unsolicited reaction from the mastering engineer, and we all know these guys hear more different products than one hundred recording engineers put together. The main difference between the two rooms at Channel is the amount of *wire* and passive components in the signal path have been greatly reduced. From this, you can see by reducing the amount of passive components in the signal path can have a much more profound effect on the product than changing consoles or switching to a different op amp in the console you already own. Even if you spend $5000 on new wire and labor to put it in that is still about forty-five grand cheaper than any new console worth considering. Even $1000 to have a good technician look at your schematics and get rid of that useless circuitry goes a lot further in improving your product than a delay line for the same money. Obviously, if you are going to go from 24- to 48-tracks you need a new console, but before you plunk down your hard earned cash take a look at an older console that you may be able to get for a song.

A NEW OUTLOOK

All of this has opened new ways of looking at how to record. It has made Jay, Michael Verdick, and myself more aware that the easiest way probably is the worst sonically. We now question whether or not we really need a function on our consoles and if not what we can do to bypass it.

I hope this will pique your interest into seeing how good you can make your product sound. Over the last decade we sure know how bad it can get. We have all become victims of that insidious malaise known as "Group Think," i.e. that's what they are doing, so it's good enough for me. In fact, it is not good enough for anybody and it is time we "Group Thought" ourselves into inquiring on how we can make it better. And the beauty of this approach is that it is cost effective because it usually means removing something rather having to buy new equipment. So the next time someone promises it is just like a "straight wire with gain" tell them if it has *wire* then you want to know what kind, how long it is, and how it sounds. ■

PETER HAMMAR

Audio Engineering Special!

Video recording for audio engineers? Read on to find out who is actually the "father" of video recording.

"AUDIO-FOR-VIDEO" has become a major development in the recording and production field during the past five years. Clearly, as a business and as an art form, audio and video are moving closer together. However, this "new" audio-video engineering synergy should come as no surprise. Both spring from the same source, audio. As a close relative, audio will want to share in an important birthday that video will soon celebrate, the introduction of commercial videotape recording in 1956.

Audio can take credit for being the "father" of other recording media, including magnetic recording. In magnetics, some of the people who originally made audio tape possible in this country and abroad also contributed directly to the creation of instrumentation, data, and video tape recording.

For example, John T. Mullin, the man who introduced Ampex and Hollywood to audio magnetic recording in 1946, developed the first working videotape recorder (VTR) prototype for the Electronics Division of Bing Crosby Enterprises in 1951. Mullin used a fixed-head, longitudinal-scan multi-channel format for his video recorder. To build the machine's transport, the Crosby engineers used parts from an Ampex Model 200 audio recorder.

Crosby sold his Electronics Division to 3M in 1957, which became their Mincom Division. Mullin joined 3M with the other Crosby engineers. In a bit of video-for-audio reverse engineering, they used the closed-loop capstan technology that Mullin had first developed for Crosby video as the basis for the transport of 3M's famous "M" series of studio audio recorders.

At Ampex, video was the figurative rib taken from the body of audio. Officially, members of the Redwood City video team that developed the first commercially successful VTR were listed as employees of the Ampex Audio Division, the name given on the cover of the "Preliminary Manual" for the machine. Ampex created a separate Video Division only after the successful introduction of the VTR in 1956.

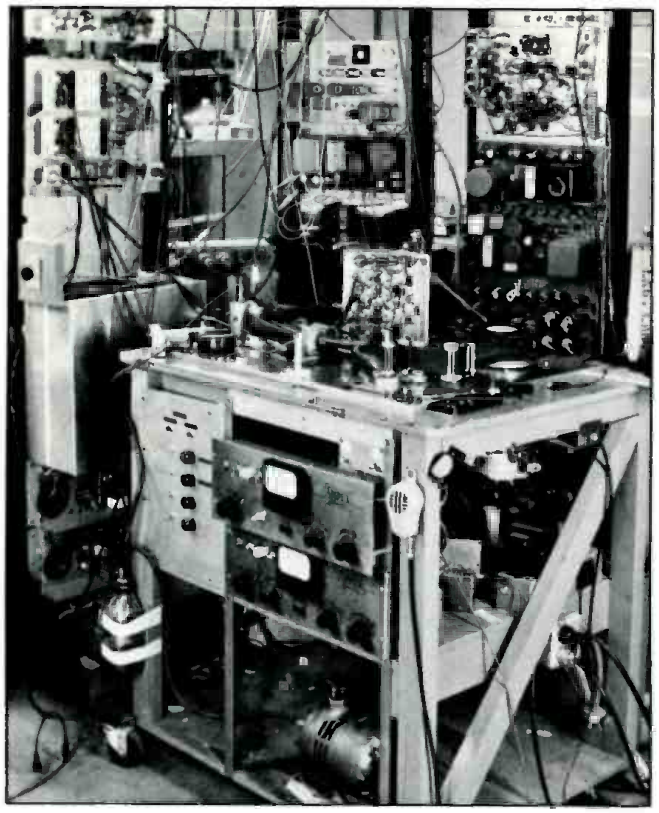
Peter Hammar is the consulting curator for the Ampex Museum of Magnetic Recording in Redwood City, CA.

You will recognize another of the many audio connections in the development of video recording, Ray Dolby of audio Noise Reduction™ fame, who became the second person to join the Ampex VTR team almost at the inception of the video project. Dolby, not yet out of school at the time he began at Ampex, made major contributions to the development of the video recording art.

Next year marks the thirtieth anniversary of the event that has affected all of us for three decades—the introduction of the world's first practical videotape recorder, the Ampex VRX-1000. It was in April of 1956 that Charles Ginsburg and his five associates unveiled their invention at simultaneous demonstrations in Chicago and Redwood City. Unlike the fixed-head Crosby, RCA, and BBC videotape recorder prototypes, the Ampex VTR was the first to use spinning heads and slow tape speeds to achieve the high writing speeds necessary for video.

This Ampex VRX-1000 started a revolution in television production methods and programming.

The thirtieth anniversary of videotape recording



Prototype of the first commercially successful videotape recorder, the Ampex Mark III VTR in early 1955.

means more than one company's milestone. The event became a watershed in the history of television, creating a new kind of program production industry in a medium dependent on live stage methods and Hollywood film techniques. Besides color video, no single technology changed television as much as the magnetic video recorder.

Nineteen eighty-six marks the beginning of the fourth decade of change and innovation in television production. The arrival of digital audio and video, with the ability to manipulate picture and sound without generational loss, represents the greatest challenge for creative program production—and audio engineering—since tape arrived here after World War II. With audio-for-video, audio people are only now fully realizing the engineering and production opportunity that video tape created back in 1956.

Starting next year, I hope audio engineers will join their video brothers in taking note of the start of the truly remarkable technology of the VTR. The best way to mark the occasion is to renew our efforts at preserving both original television programming and the machines that recorded them. But we need your help out there in the field!

Many broadcasters and production studios have old two-inch videotapes that have been squirreled away in closets and on the bottom of tape library shelves. Some people don't realize that many of these dusty, old "quad" tapes represent rare, irreplaceable video footage showing the early days of the business.

I've met broadcasters and producers who assume that archives—somewhere, somehow—have copies of all

This is the first-ever videotape recorder prototype in 1951, built for Bing Crosby.

important television and radio material. In fact, the majority of videotape masters of both national and local programming have been erased or destroyed over the years. We should help preserve these very beginnings of the industry by encouraging broadcasters and producers who have old tapes to donate them to archives for high-quality transfer to modern media, as well as for preservation of the original tapes.

The Ampex Museum of Magnetic Recording, which is not an archive, can serve as a conduit to connect the holders of early video footage with archivists around the country. The major archives can offer proper legal cover for program donors, protecting the owner of the physical media who may be holding copies of programs not originally authorized for duplication twenty or thirty years ago. The fact is, with our cavalier, throw-away attitude towards preservation in this country, much of the programming that archivists have saved was originally "bootlegged" and held by private collectors. Meanwhile, the dumpsters of certain broadcasters, networks, and producers continue to overflow with our national entertainment heritage.

Although they may not own the content, private holders of original programming who want to donate and preserve tapes and discs can easily be protected from any supposed copyright infringement involved in a donation to a non-profit archive. The major media archives can also protect program producers, owners, and other equity holders such as actors and musicians. Much of this footage is vitally important in showing the birth and development of video tape, and simply must be preserved. We are looking for early black and white and color newscasts, network or local, and old videotaped programming from any market, large or small; any recordings of network feeds from 1957 to the early 1970s of either national news events or entertainment shows; any commercial spots, local or national, that may be sitting on a shelf somewhere. And don't forget kinescopes and old films made for TV!

Naturally, any important antique hardware and accessories, video or audio, should also be conserved for the future, if for no other reason than to be able to play back increasingly outdated video and audio recording formats.

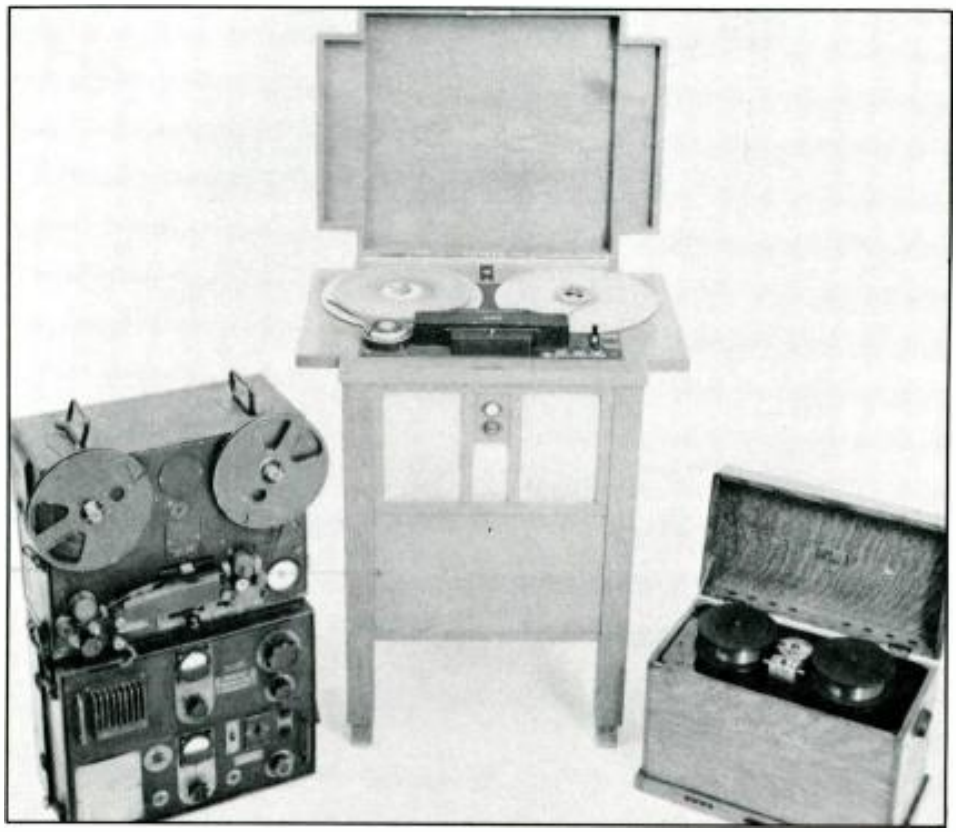
Help us save an important part of our culture. Spread the word among your audio and video contacts about the kind of material we're looking for. When you find something, arrange for donation to the appropriate archive that will preserve the original and carefully make preservation copies. Or call me, Peter Hammar, at my office at (415) 941-0295 or at the Ampex Museum in Redwood City, California, at (415) 367-3127, for further reference.

Thanks to all of you, and happy birthday! ■

PETER HAMMAR and DON OSOSKE

The Birth of the German Magnetophon Tape Recorder 1928-1945

This article is a revised version of the one that first appeared in **db** *in March, 1982. With research assistance from German media historian Heinz Thiele, the authors have added new information to their original material obtained from sources that included BASF, Agfa, AEG-Telefunken, the German radio stations, the Deutsches Museum and retired audio engineers.*



THE DEVELOPMENT OF MAGNETIC recording was not exactly an overnight event. From its introduction in 1898 as the Telegraphone wire recorder to the controversy of today's digital technology, magnetic recording has gone through stormy times.

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Valdemar Poulsen, the Edision of magnetic recording, invented almost every known form of magnetic storage. His first idea, in 1896, was a magnetic version of Edison's cylinder phonograph. Poulsen spiralled piano wire around a brass cylinder, with a laterally-moving magnetic pick-up head pushed along by the rotating cylinder. Playing time was thirty seconds. By 1899, the Dane had developed magnetic recorders that used spools pulling wire past the record head at two meters per second, with a recording time of several minutes. Poulsen

also made a machine that used a steel band to record sound. He even made a magnetic disc recorder whose pick-up head moved along a spiral guide, very much like the magnetic disc video slow-motion recorders developed by Ampex and others in the 1960s. And all this before 1900!

Unfortunately, marketing people regarded Poulsen's technical breakthroughs in magnetic recording as a curiosity, a toy. In 1905 the Danish engineer sold his Telegraphone patents to the highest bidder and went on to do research in other areas of electricity, including radio transmitters.

Lee DeForest, the inventor of the modern vacuum tube, wanted to perfect magnetic recording—many of DeForest's early Audion tube diagrams used a wire recorder as the theoretical sound source. However, DeForest's efforts were frustrated by lack of cooperation from Poulsen's successor, the American Telegraphone Company.

For shipboard radio recorders in the 1920s, U.S. Navy researchers Carlson and Carpenter improved the Telegraphone with vacuum tubes, and added something new to the record circuit—AC bias. But their Navy sponsors lost interest in communications recording and the two were forced to drop the project. Had the Navy had a bit more foresight (easy for us to say today), we might have had relatively high fidelity magnetic wire recording as early as 1923. The Navy's reaction reflected an attitude that continued from Poulsen's day: magnetic recording was more a curiosity than a practical tool.

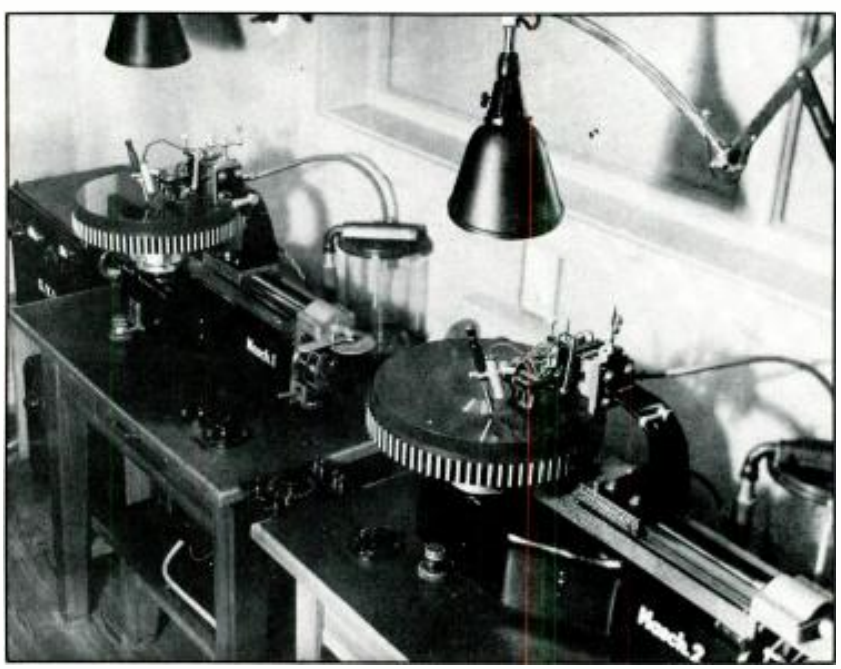
The next attempt to commercialize magnetic recording was made almost a quarter-century after Poulsen, when Curt Stille in Germany formed the Telegraph Patent Syndicate in 1927. Stille envisioned magnetic recorders for dictation, automatic telephone answering, and even music reproduction. None of the members of the syndicate was very successful in their attempt to commercialize magnetic recording, although the Lorenz Company in Berlin almost succeeded.

Around 1933, under the direction of S.J. Begun (who later headed Brush Development in Cleveland), the Lorenz Company began work improving one of Curt Stille's ideas, using a steel band as the recording medium. Lorenz had enough faith in magnetic recording to design its "Stahltonband Maschine" or "steel sound machine" for use in radio stations as a transcription device. In fact, by the mid-1930s, several European radio services, including the Germans and the British, had used steel recording on the air. Steel-band recorders had reached a quality level almost equal to the broadcast wax disc.

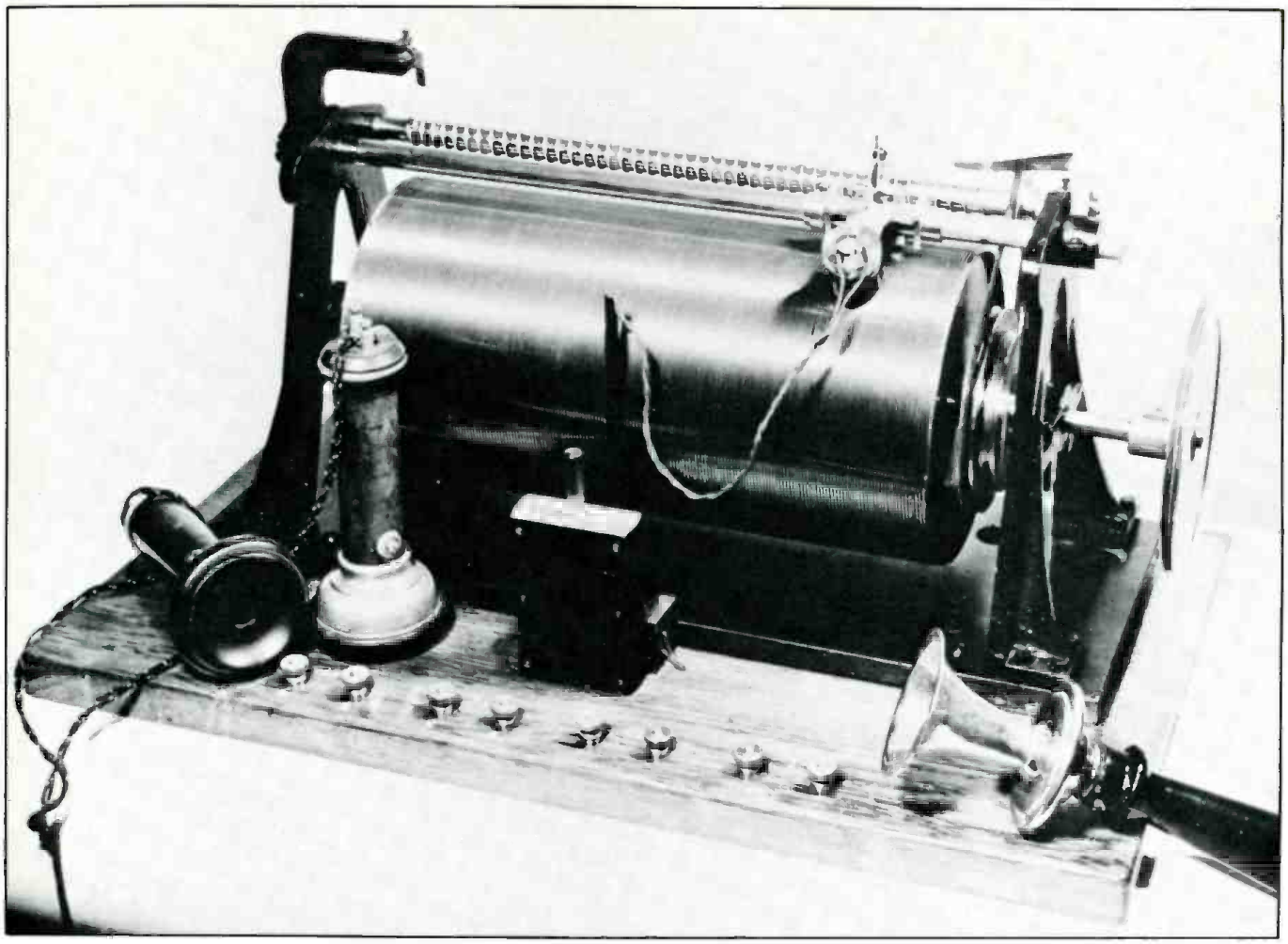
During the world-wide depression of the 1930s, people relied increasingly on radio at home for entertainment. For broadcasters, the Thirties was a time of tremendous growth in entertainment programming. Most radio stations used recording lathes to cut lacquer or very thick wax discs for use in time-delayed broadcasts. However, the wax discs could only be played two or three times before the grooves were worn. Also, the radio engineer could not easily edit a program recorded on a disc. The necessary disc-to-disc transfers to edit out mistakes led to high generational loss of sound quality.

Naturally then, magnetic recording on a long, thin strip of material offered the broadcaster editing and multiple-replay capabilities that he did not have with discs. But the Lorenz Company's steel-band recorder was out of date before they could get their machine to the broadcast market. Steel as a recording medium was impractical at best. You edited with solder and a welding torch. A fifty-minute reel of steel tape measured over two feet in diameter, and weighed almost 40 pounds!

The machines could even be dangerous for their operators. The English version, the Blattnerphone, used



Neumann wax disc recording lathes at Sender Hamburg in 1931. Recording lathes were the forerunners of the Magnetophon in German broadcasting. (Photo courtesy of the Norddeutscher Rundfunk Archives, Hamburg, Germany.)



The first Poulsen Telegraphone, circa 1898.

at the British Broadcasting Corporation until as late as 1950, was operated in a metal cage so that if the steel band flew off its reel during fast-forward or rewind, the engineer on duty wouldn't lose a hand, or worse.

The expense alone of solid steel tape was high enough to prompt the German radio service's chief engineer H.J. von Braunmuhl to look for an alternative to steel. There had to be a better answer to magnetic recording than steel band.

FROM STRAWS TO CIGARETTES TO MAGNETIC TAPE

In Dresden, Germany, the Universelle Company had been building cigarette manufacturing machines since the turn of the century. One of their engineering consultants in the 1920s was Fritz Pfleumer, whose previous discoveries included drinking straws made of plastic, as well as new forms of foam rubber.

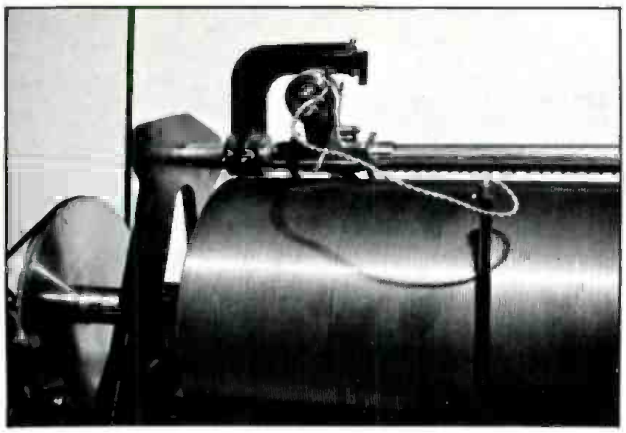
One of Universelle's machines was designed to make cigarettes with a thin band of real gold around the mouthpiece. Even for 1928, using gold on cigarette mouthpieces was becoming expensive, so the company put Pfleumer to work finding a substitute for the gold. Pfleumer developed a bronze powder that he mixed with lacquer, spread on a wide, long strip of paper, and then slit into tiny pieces for gluing onto the cigarettes.

Pfleumer was somewhat of an audiophile. He liked good-quality radios and recording devices, and did much experimenting on his own. Of course, like most engineers, Pfleumer knew about the wire Telegraphone and the early experiments with steel-band recording.

Around 1928, Pfleumer was in Paris on a business trip. While sitting in a cafe, he was thinking about magnetic sound recordings. He reasoned that, instead of using expensive, heavy steel tape for recording, he could use his cigarette-mouthpiece-label technique to make cheap, lightweight magnetic tape. Instead of bronze powder, iron powder could be mixed with lacquer and spread on a paper tape.

Pfleumer's combined knowledge of paper tapes from his cigarette work, and his understanding of magnetism and electro-acoustics was crucial to his success in making the world's first magnetic tape recorder. He knew, for example, that the iron particles had to be as small as possible to achieve the highest possible frequency response. For Pfleumer, the all-important binder material to glue the particles to the tape was no problem at all. He just used the same lacquer he had used for the bronze on the cigarette mouthpieces.

Pfleumer's first tape recorder, built in 1928-29, sounded just awful: distortion, background noise, wow, and flutter. But the point was, the thing *worked!* One did not need a solid piece of ferrous material to record sound magnetically. The engineer described his recording tape as "a 300-meter-long roll of the recording material which lasts twenty minutes and costs only one Mark 50 Pfennigs (about 25 cents) to make. The paper, called Pergamine, is only 0.04 mm thick." He pointed out that, with his new



Detail of the Telegraphone record/playback head. (Photo courtesy of the Deutsches Museum, Munich.)

recording system, the tape editor could trade his welding torch for a pair of scissors.

Unhappily for Fritz Pfleumer, the German patent office in 1936 denied him his 1928 patent, finding the American J.A. O'Neill's 1927 magnetic tape patent valid. As far as we know, O'Neill never did make workable magnetic tape or a recording device of any kind.

In 1929, Pfleumer took his invention from Dresden to Berlin, to sell it for development. Newspapers there ran stories about the new recorder, after several private demonstrations. AEG (*Allgemeine Electricitaets Gesellschaft*, or "General Electric Company") in Berlin, was Germany's second-largest electronics company, after the Siemens Company. AEG designed and manufactured professional and consumer electronic products, much as its business associate General Electric did in the United States.

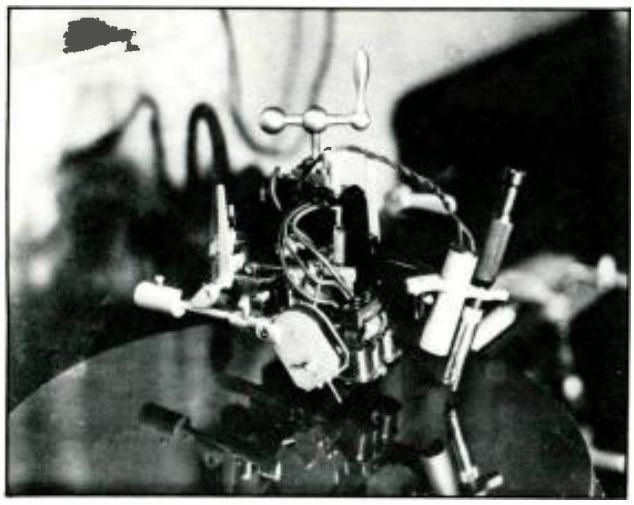
At AEG in 1930, Pfleumer's first demonstration of his tape recorder, which he called a "sound paper machine," was less than convincing. His magnetic recorder, like others before it, sounded poor. However, for the first time in history, engineers and managers were far-sighted enough to see the potential for tape recordings. By 1932, AEG had signed a contract with Pfleumer to buy his patent outright and develop tape recording.

The engineers at AEG tried to make their own tape at first, according to one account, buying carbonyl iron at the corner drugstore and spreading it on paper "ticker tape." The sound they got from the tape was terrible, and they soon realized that the problems of spreading thin coats of iron-filled lacquer onto strips of paper tape were best left to a chemical concern.

THE FIRST TAPES

In the early 1930s, the chief executive officer of AEG, Herman Buecher, heard about his engineers' problem. He called his old friend in Frankfurt, Carl Bosch, who was the head of the powerful IG Farben chemical

In 1938, the German radio or "Reichsrundfunk" became the first broadcaster in the world to adopt tape as its transcription and time-delay standard. Shown are AEG Magnetophon K-4 "HTS" AC-bias models at Radio Kiel, circa 1943.

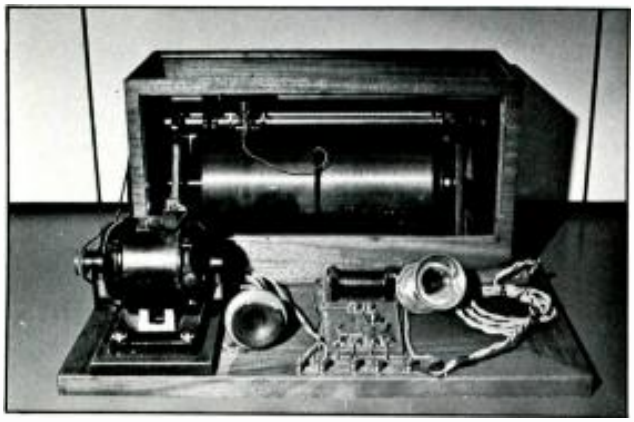


Neumann disc cutting head, in use circa 1931 at Sender Hamburg. Both wax and lacquer discs were used for the broadcast-quality recordings. (Photo courtesy of Norddeutscher Rundfunk Archives, Hamburg, Germany.)

combine, to see if the two companies could make the development of the magnetic tape recorder a joint venture. In 1932, AEG's Buecher and IG Farben's Bosch arranged for a member of the IG Farben group BASF, (*"Badische Anilin und Soda Fabrik"* or "Baden Anilin [dye] and Soda Factory"), in Ludwigshafen, to begin intensive research into the problems of making good magnetic tape for the new AEG machine.

The first BASF tapes made in 1934 for the Berlin Radio Show was made of pure, powdered carbonyl iron. The iron, which looks like black dust, was mixed with lacquer and spread onto a cellulose acetate film, which was then cut into five millimeter-wide strips (6.35 mm = ¼ inch) several hundred meters long. BASF's first tape had no trade name, and was simply called "IG Farben carbonyl tape." Mechanical problems with AEG's prototype Magnetophon postponed the planned 1934 unveiling of the new recording process until the Berlin Radio Show the next year.

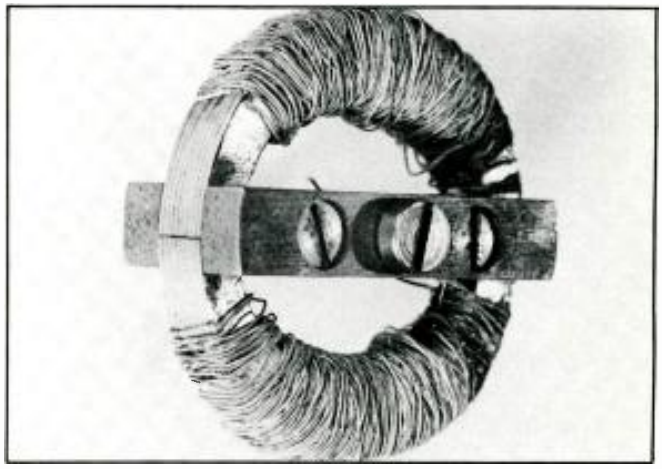
By 1935, the researchers at BASF had progressed from carbonyl iron to iron oxide with smaller magnetic particles that resulted in better electrical performance. Today's iron oxide tapes are essentially refinements of these early BASF formulations.



Poulsen Telegraphone, complete (1899). Poulsen intended this device—record/PB time = 30 seconds—to be an automatic telephone answering machine. (Photo courtesy of the Deutsches Museum, Munich.)

At the start of their joint venture with AEG, BASF switched from paper to a cellulose-acetate film. The early carbonyl iron tape was brittle, but much stronger than the first paper tapes. BASF's trade name for their acetate basefilm was "Cellite," so they called their new iron-oxide formula tape "Type C." Manufactured through 1942, Type C tape had a rust-colored oxide with a gray backing.

By 1943, BASF had introduced a third kind of tape. Luvitherm or "Type L," a homogeneous tape/basefilm of polyvinyl chloride. Though much stronger than the Type C acetate tape, the PVC did stretch. Type L tape was made by dumping the iron oxide into the PVC vat, and then extruding the mixture into a solid film. Because the iron oxide was mixed throughout the tape, Type L could be recorded on either side. Another IG Farben member, Agfa at Wolfen, later joined BASF in the production of



The first "ring head," invented by Eduard Schueller in 1932 at the Heinrich Hertz Institute in Berlin. Schueller joined the AEG Magnetophon team in 1933, bringing with him his ring head patent.
Photo courtesy of AEG-Telefunken Archives, Braunschweig, Germany.

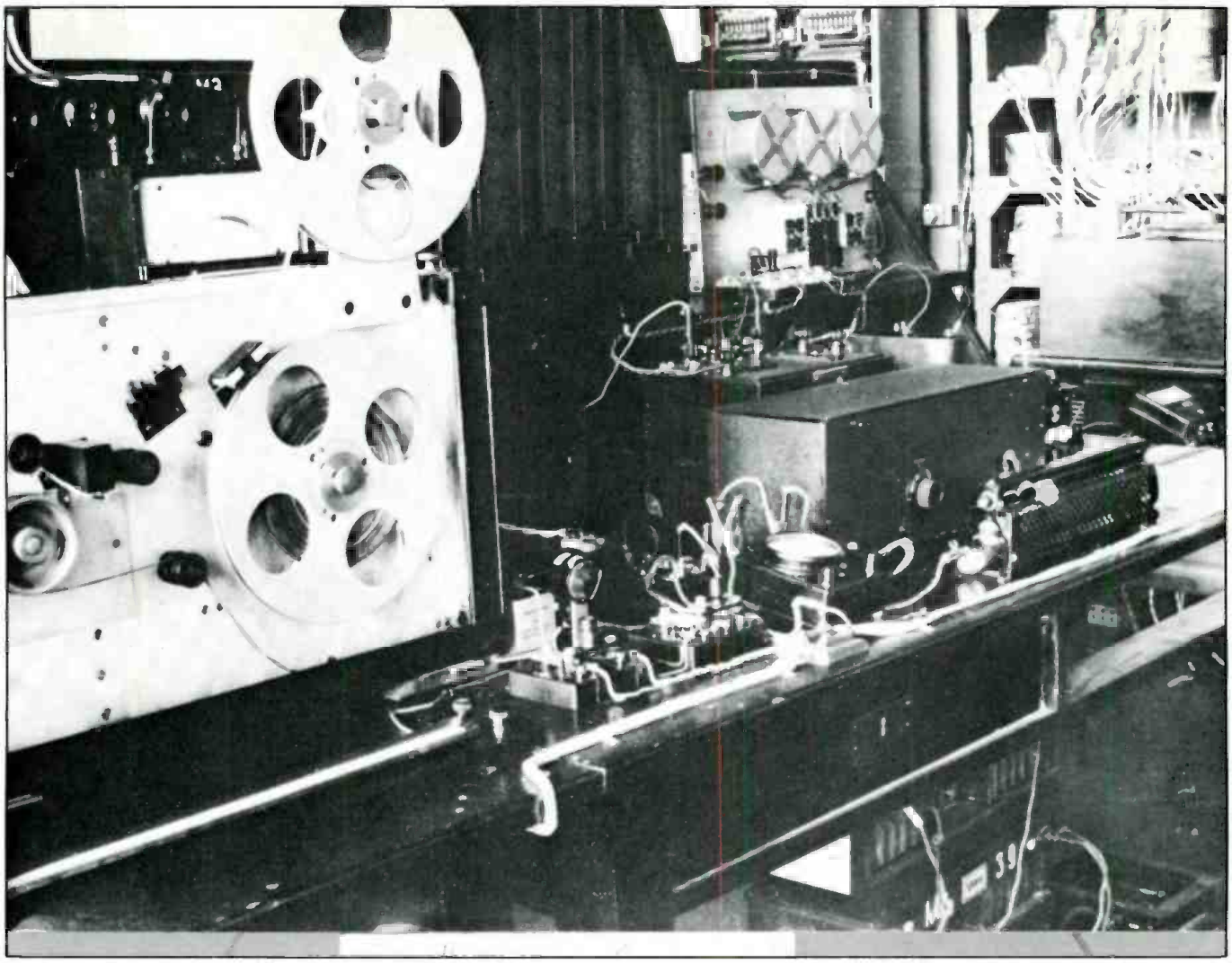
recording tape. In 1944-45, American GIs invading Northern Europe found a lot of Type L tape. Both BASF and Agfa were able to steadily increase their tape production until war's end in May of 1945.

The origin of today's one-quarter inch tape width standard came from a combination of good engineering and coincidence. In 1935, just before the introduction of the first AEG/BASF recorder and tape, the companies jointly decided to widen the tape from its original 5.0 mm to 6.5 mm (just a hair over one-quarter inch). The engineers chose the wider tape for greater strength and better electrical performance. We still do not know why they chose the number 6.5 mm.

When the Allied engineers examined the captured Magnetophons and their BASF/Agfa tapes, they measured the 6.5 mm width as a quarter inch, plus or minus "a tiny bit." The 0.15 mm difference between a quarter inch and 6.5 mm was really not worth noticing. With the interruption of German tape manufacturing at the end of the war and the importation of American 3M (Scotch), Orradio (Irish), Audio Devices and other tape, the official width of magnetic tape there became 6.35 mm as well.

THE MAGNETOPHON

Our thirty inches-per-second base tape speed also originated in Germany with the Magnetophon. Until 1935, the AEG/BASF R & D team used one meter-per-second as their nominal standard tape speed. However, the recorder/reproducer suffered from poor mechanical



The first laboratory prototype of the AEG "Ferroton" tape recorder in the fall of 1933. The one-motor machine used 5mm-wide carbonyl iron paper tape that was pulled past the heads at one-meter-per-second. (Photo courtesy of the AEG-Telefunken Archives, Braunschweig, Germany.)

performance. The selection in 1935 of a new AEG asynchronous motor for the capstan drive solved some of the problems. In an effort to simplify future production of Magnetophons and set a world-wide standard, the engineers specified a capstan diameter of 10 mm. ±0. A ten-millimeter capstan with AEG's asynchronous motor and the BASF tape produced a tape speed of 76.8 centimeters-per-second. If the production of the Magnetophons could be standardized, an odd tape speed really would not matter.

When Major Jack Mullin, one of America's tape pioneers, and his U.S. Army Signal Corps engineers measured the Magnetophon's tape speed, they were surprised to find it to be almost exactly 30-inches-per-second (76.2 cm/s). Mullin's Magnetophons inspired the creation of the Ampex Model 200, America's first commercially-successful professional recorder. In 1947, Harold Lindsay, the Model 200's chief designer, used Mullin's 30 ips figure in the American machine's design, which later became the U.S. standard. Mullin had lent Lindsay some of his precious pre-recorded Magnetophon tapes for test purposes, thus the logical choice of a 30 ips tape speed for the American machine.

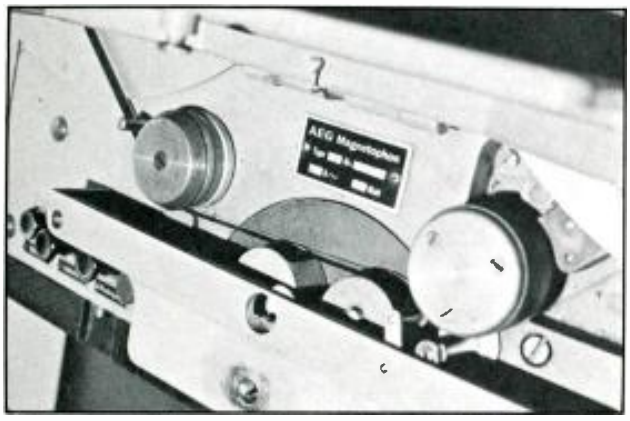
With the postwar dismantling of the Magnetophon factories, American machines dominated the European recording market in the early 1950s. The Germans adopted the U.S. figure of 30 ips, converting the number back to the metric 76.2 cm/s. No one ever seemed to notice the difference.

From the start of the Magnetophon project AEG faced the difficulty of building good heads. The heads originally developed by Poulsen and found on wire and steel-band recorders consisted of pole pieces with sharpened points pushed by springs onto the surface of the recording medium. Early experiments with the old-style pole-piece heads showed that these heads had electrical disadvantages. The magnetic lines of force from the pointed heads with their separate pole pieces were both horizontal (parallel to the axis of the tape travelling past it) *and* diagonal. The lines of flux which intersected the tape were unfocused and mostly ususable, even interacting with each other to create distortion.

THE RING HEAD

The solution was an invention by Eduard Schueller: the enclosed ring head. Schueller had worked as a research

assistant at the Heinrich Hertz Institute, a technical "think tank" in Berlin, and by 1932 was already experimenting with ideas of magnetic recording. Schueller found that the most important part of successful magnetic recording was the head. He decided to improve on the open pole-piece head design. The result was his experimental ring head. AEG soon offered



View of head assembly and tape path of AEG Magnetophon K-2 (1936), the portable version of the FT-2 shown on the March db cover. (Photo courtesy of AEG—Telefunken and Ampex.)

Schueller a key position on their tape recorder development team. Schueller's ring head created the nearly ideal magnetic flux pattern necessary for better fidelity recording. The lines of flux were concentrated in their most useful direction, horizontally (in the direction of the tape).

Thanks to the AEG-Telefunken Archives, BASF, the German Radio Archives in Frankfurt, and Hans Westphal of Berlin, we have copies of the earliest recordings made on the AEG prototype recorder in 1933. On the first recordings, the frequency response limit was not more than 3 or 4 kHz, harmonic distortion was about ten percent, and the signal-to-noise ratio was quite poor. By 1935, with the introduction of AEG's first production machine, the "Magnetophon K-1," fidelity had been increased, with frequency response to beyond 5 KHz and wit less distortion.

By 1935, the Germans had three of the four necessary ingredients of modern tape recording: 1) a stable transport, which the steel band recorders such as Lorenz had; 2) good tape, which the researchers at BASF had created; and, 3) the ring head from AEG's Schueller, with its good magnetic properties and gentle treatment of fragile tape. The fourth element of magnetic hi-fi recording, good electronics, would have to wait until 1939-40, after the Second World War had started.

From Valdemar Poulsen at the turn of the century until the late 1930's, direct-current biasing was the only method known to European engineers to reduce noise and distortion and increase frequency response. As late as 1939, the DC-bias Magnetophon sounded no better than an average 78 rpm transcription disc.

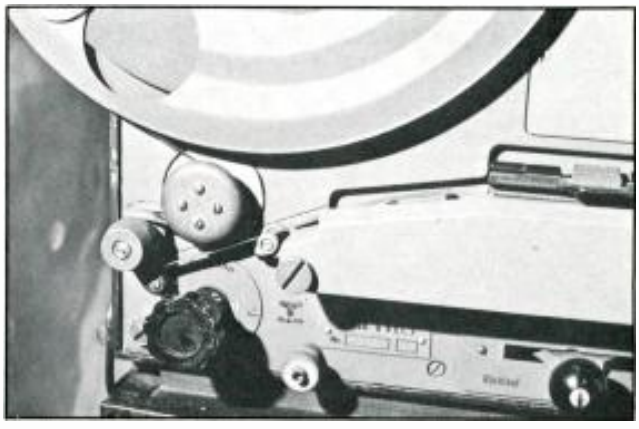
Although AEG initiated the development of the modern tape recorder, it may have been BASF that gave the machine its name. One of the names used by the engineers at AEG in 1932-33 for their new machine was "Ferroton." At BASF, they were calling their tape "Magnetophonband" or magnetic phonograph tape. The name stuck, and in 1935, AEG started calling the machine the "Magnetophon." The name is still used in Europe today.

Until 1945, most engineers around the world had not heard of the German tape recorder. It was the combination of DC bias and World War II that kept the Magnetophon in obscurity. Jack Mullin has said that, "Once you hear DC-bias recording, you'll never want to hear tape again!" Sir Thomas Beecham, having heard his London Philharmonic on tape in November of 1936, reportedly was so horrified by what he heard that he didn't use tape again until 1950.

In 1936, AEG sales people took their new Magnetophon to America for a secret demonstration at General Electric in Schenectady, New York. The DC-bias unit sounded so bad to the Americans that they decided that magnetic recording, at least in that form, was not practical.

The most promising market for the then-unperfected magnetic recording machine in Germany in the 1930s was the Berlin-based German radio monopoly, known as the RRG (*Reichs Rundfunk Gesellschaft* or "Empire Radio Company"). The chief of the RRG engineering section, H.J. von Braunmuhl, was against using magnetic recording for broadcasting. He liked the tried-and-true wax disc recording lathes with their Neumann heads. However, the progress of the AEG and BASF engineers interested him.

Von Braunmuhl bought several DC-bias Magnetophons and put his best engineer, Walter Weber, to work to see if the machines really could be improved enough to be used on the air. Meanwhile, the people at AEG was also hard at work trying to perfect magnetic recording.



Spinning head (4 gaps, 90 degrees to tape path) of Tonschreiber "Berta"; made by AEG, Berlin, circa 1939. (Photo courtesy of AEG—Telefunken and Ampex.)

Weber at RRG had an idea of how to improve the signal-to-noise ratio. He cancelled some of the noise by adding an inverting bridge circuit with a "dummy" record head to the record amplifier circuit. The resulting 180-degree phase shift reduced tape noise about three dB.

AC RECORD-BIAS

One day in 1940, Weber was experimenting with this circuitry, making recordings of music and speech as well as pure tones. Weber kept logs of which recorder he had used, time of day, and what he had recorded. Later, while playing back one of the tapes, Weber found that the sound was fantastic! He was hearing true high fidelity on tape: extended frequency response, low noise, and low

The disc transcription room, Sender Hamburg, circa 1935. (Photo courtesy of the Norddeutscher Rundfunk Archives, Hamburg, Germany.)

distortion. He traced the recording back to a Magnetophon that used his new noise reduction circuit, checked that circuit, and found that it was in constant oscillation, dumping high-frequency feedback into the record circuit. Weber realized that AC record-bias was *the* answer to hi-fi tape recording. He spent the rest of 1940 perfecting his AC-bias discovery.

After the boss of the AEG Magnetophon lab across town heard the results of Weber's breakthrough at RRG, he went to his own researchers and said, "What in the world have you guys been doing here, sleeping? Over at RRG, they've just discovered AC bias and turned *our* machine into a high-fidelity recorder. We've got to get on the ball here!"

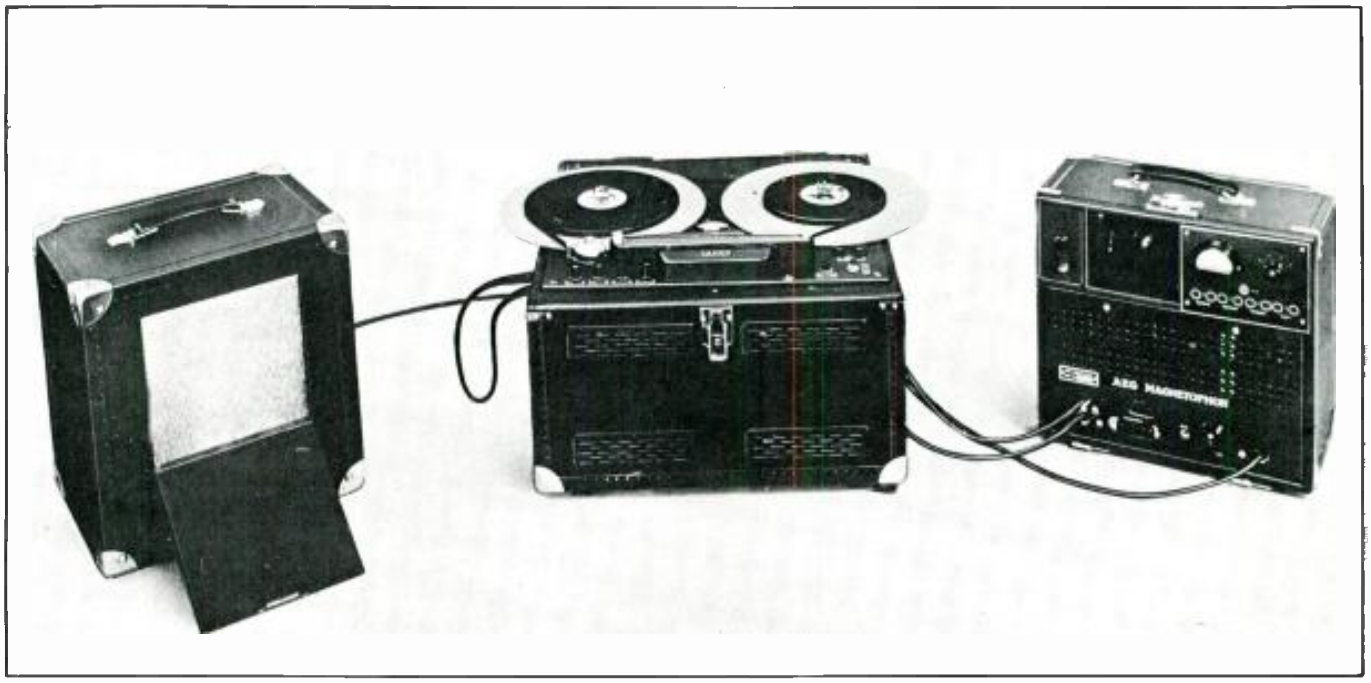
In fact, AC biasing of the record circuit was nothing new. But times were different, and engineers often missed each other's progress. Back in 1927, the U.S. Navy engineers Carlson and Carpenter, using a Telegraphone, had noticed the improvement of AC bias on wire recordings of telegraph messages. About the same time that Weber discovered AC biasing for tape recorders, Marvin Camras of the Armour Research Institute in Chicago had a similar discovery for use with his improved wire recorders. And before and during World War II, S.J. Begun of Brush Development in Cleveland applied AC bias to some of his wire and steel-band magnetic recorder designs.

With the war already in progress in Europe by 1940, it wasn't too surprising that Weber and Camras had not heard of each other's discoveries. In the late 1930s, the Japanese, under Kento Nagai, also discovered the AC-bias phenomenon on solid magnetic material.

After the war, the Allied Commissions in Germany and Japan declared all international patents of the Axis powers invalid. That left the quite advanced Armour patents as the finisher in the post-war AC bias license field.

For AEG, the beauty of Weber's discovery was that they could take their existing DC-bias design and simply add the relatively simple AC-bias circuit, while changing the record head only slightly. The playback of the DC-bias Magnetophon was quite good, although its full potential was never realized before AC-bias recording. The last production DC-bias Magnetophon had a specified frequency response of 50 Hz-6 kHz, a dynamic range of 40 dB, and harmonic distortion of 5 percent. The first AC-bias Magnetophon was rated at 40 Hz-15 kHz, with a 65 dB dynamic range, and under 3 percent distortion.

Most of the studio Magnetophons in use at the end of World War II were designed as early as 1938. The first



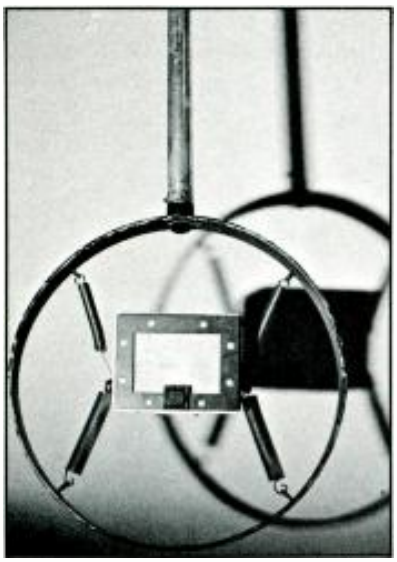
An AEG Magnetophon K-4, circa 1938. The DC bias version had a frequency response of 50 Hz-6 kHz, 5 percent distortion and a dynamic range of 40 dB. Once modified with Walter Weber's AC record bias, the frequency response improved to 40 Hz-15 kHz, with a 65 dB dynamic range and less than 3 percent distortion. (Photo courtesy of the AEG-Telefunken Archives, Braunschweig, Germany.)

production Magnetophon, the portable K-1, appeared in 1935. ("K" stands for the German word *Koffer* or "portable case.") The machine came in three cases, one for the transport, another for the electronics, and a third holding the loudspeaker. At the same time, AEG produced the cabinet "FT" series Magnetophon *Ferngesteuertes Truhe*, or "remote control cabinet"). The K-2 and FT-2 were introduced in 1936. The only FT-2 in existence that we know of is now a part of the Ampex Museum of Magnetic Recording in Redwood City, California.

The K-3 and FT-3 in 1937 were followed by the final Magnetophon in the pre-1945 series, the K-4, in 1938. The K-4 is the best-known pre-1945 Magnetophon. This is the machine that Jack Mullin and his partner, San Francisco filmmaker William Palmer, used to introduce America to the new technology of hi-fi tape recording.

The 1938 K-4 had DC biasing, and after the introduction of AC bias in 1941, a few early K-4s were updated. AEG also made an agreement with the RRG radio people to deliver K-4 decks built to RRG specifications incorporating the AC-bias design. The radio station console machines that Jack Mullin first saw at the Radio Frankfurt substation at Bad Nauheim in July in '45 werre special K-4 HTS ("Handgesteuertes Truhe Speziell," or "locally-controlled special cabinet" model).

When the war started, everyone in Germany was ordered to switch over to building military products. That was as true for tape recorders as for coat buttons. AEG produced a very rugged, portable DC-bias version of the Magnetophon that they called the *Tonschreiber* or "sound writer." The best-known of the Tonschreibers was



Telefunken "Reisz" microphone, circa 1930, carbon-type, in solid markble housing, 50 Hz-6 kHz. (Photo courtesy of AEG-Telefunken Archives and Ampex Museum.)

the Type B, or *Berta* machine, which appeared in 1939-40. Berta was unusual because the machine had an extra, spinning head which could be used to compress or expand sound for high-speed transmission of information.

An amazing fact of World War II was that no one on the Allied side seemed to have heard about the hi-fi Magnetophons until the end of the war. This ignorance is even stranger when you consider that popular German magazines and newspapers, publicly sold in neutral Switzerland, printed numerous feature articles about German radio stations. Had the Germans classified all information about the AC-bias Magnetophons as "top secret," the Allied probably would have known about the machines before the end of 1940! As it was, they had to wait another five years.

October, 1934 Sender Hamburg remote broadcast recording on a Hamburg commuter train, using the Lorenz Steeltone machine. (Photo courtesy of the Norddeutscher Rundfunk Archives, Hamburg, Germany.)

During World War II, the Allies were sometimes confused about Hitler's location. Live-quality broadcasts of his speeches simultaneously came from all parts of Germany. The Allies suspected some sort of high-fidelity recording device, but they overlooked the fact that the Germans had an extremely advanced radio network. A complex web of high-quality land lines (10 kHz bandwidth, 600 ohm balanced line, less than 1 dB loss per 1000 km) allowed remote broadcasts from any location to any other location. In addition, time delay broadcasts had been standard procedure in Germany since the mid-1920s. To this day, old RRG engineers are amazed and baffled to hear that Americans thought that the Magnetophons were being used to deliberately confuse the Allies as to the location of high Nazi officials.

In England between 1942 and 1944, Major Jack Mullin and others had been hearing late-night German broadcasts of live-quality orchestral music. Mullin thought that even a madman like Hitler could not compel tempermental musicians to play at three a.m. However, the audio quality of the transmissions was much better than any recording device Mullin knew. What he heard was the routine use of the Magnetophon, which had been developed as a professional and consumer entertainment device.

The Magnetophon tape recorder naturally got sucked up into the German war effort. The chief of the AEG Magnetophon lab during the war, Dr. Hans Schiesser, said that he had received specific orders from the Nazi government to work exclusively on the DC-bias military Tonschreibers for use by the army, air force and navy, and to ignore further civilian tape recorder development until after the war. However, Schiesser kept a secret set of lab notes in which he wrote of his work on high-fidelity magnetic recording, including experiments with stereo record and playback heads, which he quietly did on the side at some personal risk. For Hans Schiesser and many others at AEG and German Radio, the Magnetophon tape recorder was the exciting way into the future of high fidelity reproduction of sound. ■

PROFILE:

MURRAY R. ALLEN

Universal Recording Studios

If you can't do it at Universal, it can't be done. Read on for the full story of a studio that had to do it all by itself.

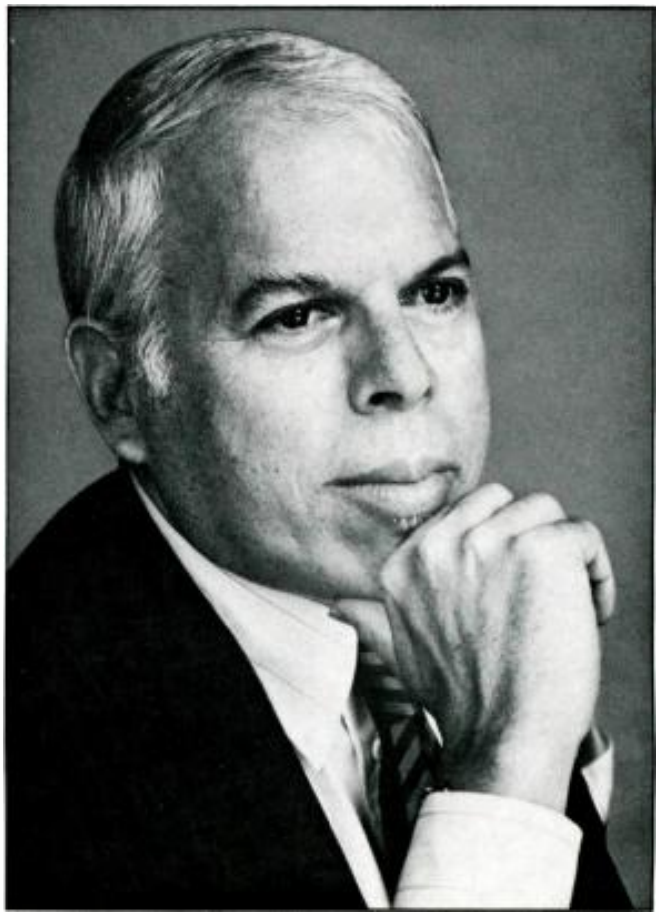
WHEN UNIVERSAL OPENED its doors for business almost forty years ago, it was pretty much on its own. There were no equipment rental companies. There were just a few manufacturers of recording equipment and they had no field support. And to make matters worse, nobody would share information with anyone else who remotely smacked of being in the same business. Unlike the two coasts, when Universal needed a special transfer it did not have another company four blocks away who specialized in such a service. Universal had to learn to do for itself. Clients would come back and tell Universal of the newest device in New York or Los Angeles. The following week Universal provided the same device in Chicago.

The one most important rule that Universal has followed throughout all of its growth is that whatever is added in the way of equipment and services must meet the highest standards of the professional audio field. Nothing has been added just for hype.

Today Universal lists among its clients every other recording studio in Chicago and a couple of majors in New York and LA, just about every major advertising agency in the world, all of the big five record companies and most of the major motion picture companies in Hollywood. Also, let's not forget the blue chip corporations and publishers. It is impossible to turn on prime time TV and not hear something recorded at Universal.

Universal is comprised of two film mixing theaters, three 48-track music scoring and video post-production studios, two 16-track music scoring and video post production studios, one 8-track media studio, two 4-track media studios, four film/video transfer suites, one optical

Murray R. Allen is the president of Universal Recording Studios.



Murray Allen.

Recording PBS radio theatre is studio C.

transfer suite and three tape copy rooms. Also, a search and storage room for music libraries and a zillion sound effects. Universal has enough room in its tape vaults to store over 25.000 sessions and they mean 24-track sessions.

Universal has also been a leader in the area of digital recording. After six years of experience in this field it proudly boasts of owning six digital recorders encompassing 32-track digital machines, 4-track digital machines and 2-track digital machines from such manufacturers as 3M, Sony and Mitsubishi. In fact, Universal was the first studio in the world to develop a system whereby a digital recorder could talk to a Necam computer.

Let's take Universal apart piece by piece to see why it's the ultimate as a one stop recording studio. Let's start with Studio A.

This is the largest room in the midwest. It measures 68,000 cubic feet, and can handle the Chicago Symphony Orchestra comfortably. Studio A is a 48-track music scoring/video post production room. This room has been used to score the Blues Brothers Film, record stars from Stevie Wonder to The Police, Grammy winning albums plus many Clio winning spots. Phil Ramone has been quoted as saying, "If the walls of studio A could talk, we would hear the history of modern music."

The console is a Neve 8048 with Necam. The digital tape machines are a 3M 32-track, a 3M 4-track and a Mitsubishi X-80. The analog tape machines include a pair of MCI 24-track recorders, an Ampex 102 and an Ampex 104. Video-wise there is a JVC 8250 with all machines looking at a BTX Softtouch System. There are five monitor systems available on a moment's notice. There are two live room chambers, two EMT 140-S plates and a Lexicon 224x with Larc for echo. In addition, there are about seventy-five additional pieces of processing equipment from Pultecs to Quantecs to help get any sound you may desire. Musical instruments include a Bosendorfer 9.5-ft. Imperial Grand piano with a 97 key keyboard, a Fender Rhodes, a celeste, a Hammond B-3, a tack piano, several drum sets to choose from and a complete set of tympanies. Universal probably has the greatest collection of microphones anywhere. You can find almost any microphone ever made from several C-12s and U-47s through today's 414s. Of course, any synthesizer you might want is available as well as 16mm and 35mm full screen film projection.

Now for studio B. This studio, like studio A, is a 48-track music scoring/video post-production room. Artists from Nat King Cole to Prince and from Sir George Solti to Little Wally and his Polka Kings have recorded in studio B. Let's not forget Dizzy Gillespie. The console is an SSL 6000 Series with total recall. It has the same digital and analog machine components as studio A. It also has a dedicated JVC 8250/BTX Softtouch package similar to studio A. For echo there's a live room chamber, a stereo EMT plate and another Lexicon 224. The piano is a 7-ft. Steinway. You have the choice of one of their five Fender Rhodes or many drum kits to fill out your instrument needs. Of course, there are all those microphones and processors as well as 16mm and 35mm full screen projection.

The Backroom is another 48-track music scoring/video post-production room. One of the 24-track machines in this room is convertible to a 16-track recorder, a video quad lay back machine or a C-format lay back machine. However, Universal likes to perform its C-format layback in a professional manner, so it also has a C-format video machine in this studio. There is also a dedicated

BTX Softtouch/JVC 8250 video system. As this studio is used a great deal for overdubs and foreign language recording the studio cue has 6 channels and a stereo mixer at every earphone position. The console is an MCI 628. Other tape machines include Ampex 102s and an Otari 4-track. This studio also has its own Steinway 7-ft, piano. For echo, there are EMT plates as well as its own Lexicon 224. Of course, all of the above mentioned

Rock set-up in studio A.

goodies from studio A and B are available too. Various artists from Gary Coleman to Ray Parker Jr. have recorded in the Backroom.

Now to the film division.

Theaters one and two are placed back to back separated by a large machine room. Both theaters have multitrack ADM consoles with total machine control at the console. This includes start/stop and high speed shuttle controls, advance/retard controls, all in/out record functions, and BTX Softtouch controls for non-sprocket/video synchronization. Both theaters have 35mm, 16mm and full screen video projection. The consoles have 4-band equalizers on every fader as well as programmable graphic equalizers. Naturally, each theater has echo, several digital delays, and digital reverb systems designed by Lexicon. You will also find dip filters and compressors in both theaters as well as JVC 8250 video recorders.

The machine room contains twenty-seven Magna Tech high speed dubbers and recorders. These machines have a total of fifty-seven heads giving the client the option of 6-track, 4-track, 3-track, 2-track and/or monaural play/record. If so required, Universal can give the producer seven 4-track recorder/dubbers at the same time. These machines run at 24 frames, 25 frames and 30 frames per second. They are capable of looking at 50 Hz, 60 Hz or 59.94 Hz as a sync source. In the 16mm mode they have both edge and center track. Naturally, Dolby units are available—on special request, up to 96 channels worth.

Universal also offers computerized ADR using both 35mm, 16mm film, and/or video. Another popular format is the synchronization of digital non-sprocket equipment with the film dubbers either for playback or record. The final master mix can be on film, audio, digital, U-matic or C-format video. By the way, about fifty percent of the national commercials aired on the 1984 Olympics were mixed in these theaters.

The four film transfer rooms are capable of handling 480 different combinations from 50 Hz, 60 Hz, stereo Nagra center-track to standard or drop frame time code looking at either line frequency, 60 Hz crystal or 59.94 Hz house sync to 25 fps, 24 fps to 30 fps be it 35mm 6-track, 4-track, 3-track, mono or 16mm edge or center or both.

The optical transfer facilities are the only full time operation of its kind in Chicago.

Studio C is a 16-track music studio. The console is designed and built by Universal's staff. The recorders are a Teac 16-track, an Ampex 800 and an Ampex 102. For echo there is a live room chamber and an EMT plate, plus its own package of peripheral gear. Studio C has access to all of the company's other goodies. The piano is, of course, another 7-ft. Steinway. This Studio has recorded from comedians like Imogene Coca to actors such as Robert Duvall.

Another 16-track studio is called Universal Prudential. This room is a media/video post production suite. It can handle up to eight voices at one time. The console is custom designed along the lines of a Quad Eight. Along with four Ampex 2-track and full-track machines there is a Teac 16-track recorder. The echo is an EMT 140-S. The video package includes the JVC/BTX Softtouch System found all around the company. Naturally there is a total peripheral package to support this type of recording. From Louis Nye to William Conrad, this studio has recorded some of the major voices in the industry today.

In addition, there are three 4-track/8-track voice studios used for slide film and radio production. Each of these rooms has four machines, custom consoles, and a peripheral package to match its needs. For a complete list of artists that have used these, as well as the rest of

Large scoring date in progress at Universal's studio A.

Universal's studios, write to Universal Recording at 46 E. Walton Pl., Chicago, Il 60611. They probably will send you one of their award winning brochures.

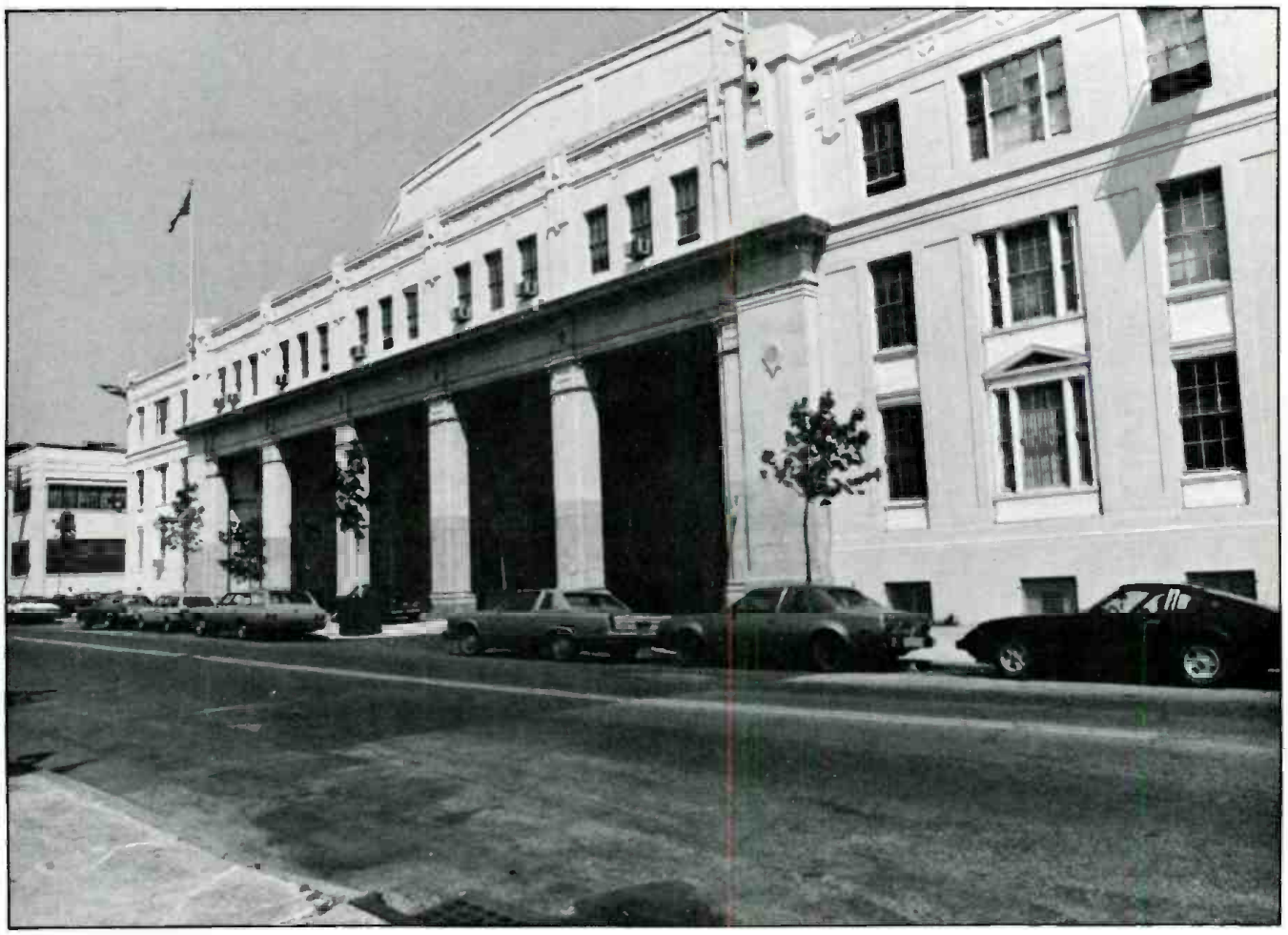
But equipment isn't everything. The people who work at Universal are very special too. Among the 37 persons employed at Universal you can find someone that will speak just about any foreign language that you will hear in the recording business. Eighteen are accomplished musicians and most are college graduates. The tech department has four men with B.S.E.E. degrees. The number of gold records, Clios and other awards won by people on Universal's staff numbers into the hundreds.

If you can't make it to the AES, NAB, or SMPTE conventions, drop by Universal. It's probably the next best thing. ■

Master Sound at Movie Studio

SAMMY CAINE

Master Sound Astoria is located in the heart of Kaufman Astoria Studios and spent over one year in the planning at a cost of over three million dollars. We bet you would like to know a bit more about the place...



Main building at Kaufman Astoria Studios.

MASTER SOUND ASTORIA (MSA) is located in the heart of Kaufman Astoria Studios, a fourteen-acre complex that has been declared a National Landmark. The complex houses eight sound stages totalling more than 65,000 square feet, a pair of radio stations, and an array of production offices including producers, directors, writers, editors, record companies, and suppliers. It can be the center of a continuous pre-production, shooting, and post-production schedule for feature films, television productions, commercials, teleconferencing, cable TV, videodisc production, satellite distribution, closed circuit TV, corporate communications, and other audiovisuals.

The studio itself occupies over 14,000 square feet at the center of all this, is ready for film scoring, and is large enough to accommodate a full orchestra. It is hard wired to three of the sound stages (stage E, 26,040 sq. ft.; stage G; and stage H, at 12,000 sq. ft. each), with 100 mic inputs and audio/video monitor communications for each. This will allow major live music videos to be shot and gives the ability to sync high quality audio with any film or television scene.

Sammy Caine is the technical editor of db *Magazine as well as a freelance recording engineer.*

STUDIO DESIGN

The abilities of Master Sound are virtually limitless. This is due to the huge amount of pre-planning by Ben Rizzi and Maxine Chrein who originally started Master Sound in Franklin Square, NY in 1971. The studio initially opened as a small 4-track studio but it rapidly grew into a major 48-track, state-of-the-art facility, handling all types of recordings. The studio represents over a year of planning and three million dollars in design and construction costs. Computers were used to assist in the design of such things as the air conditioning system which is capable of fifteen-tons and is totally silent.

The studio itself was once used by the Army Corp of Engineers for various recordings. The old control room was isolated from the studio by 1,500 lb. doors, but it was too small for the control room planned by MSA. So the obvious choice was to build a new control room and use the old one as an isolation booth. The new control room was built to exacting specifications and utilizes walls consisting of industrial particle board (weighing 100 lbs. per 4 x 8 sheet) and Celotex which is then sealed in lead and faced with neoprine, with a $\frac{5}{8}$-in. layer of sheet rock on top of all that. The design was unique in that the room was planned to be able to reproduce any sound the studio itself is capable of.

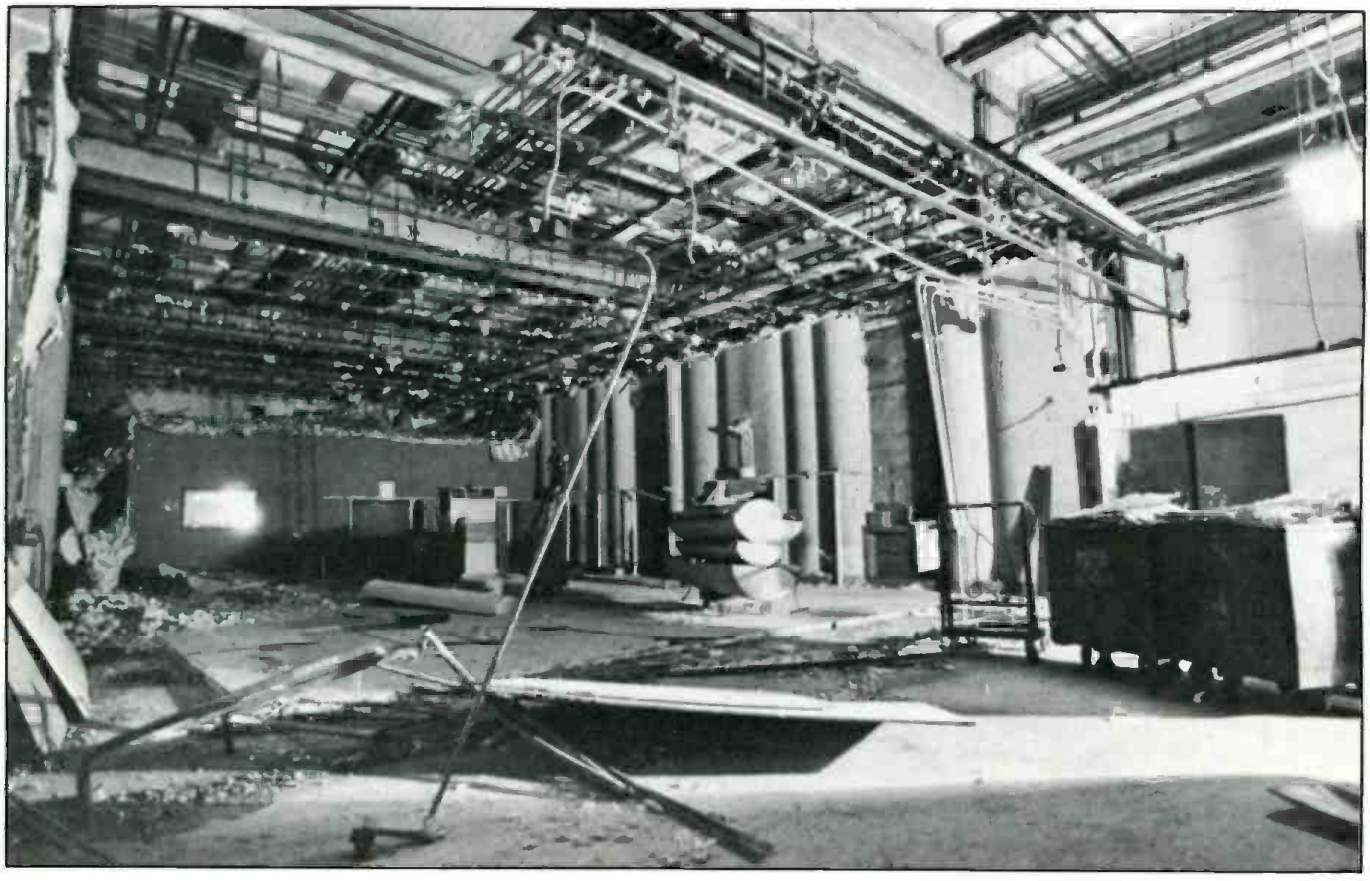
The studio's walls are based on 2 x 6 heavy gauge steel studs with $\frac{5}{8}$-in. sheet rock, 1-in. core board, a layer of lead and then another layer of $\frac{5}{8}$-in. sheet rock. This design was necessary since the studio is located directly below a large sound stage. We all know what would happen if they were filming a quiet love scene on the sound stage while the Who or some other loud rockers were laying down rhythm tracks at Master Sound.

The studio and control rooms are completely airtight and utilize double floating ceiling construction with industrial particle board. Invariably, with this type of construction, problems came up when trying to design something as simple as a pipe to run the sprinkler heads into the control room. Special lubricating grommets had to be custom fabricated to allow the heads to extend into the ceiling without breaking when the floating ceiling moves up and down with the changing air pressure in the room.

EQUIPMENT

A Trident console sits on a sand-filled platform that is flanked by a pair of enclosed (sliding glass doors) alcoves for the multitrack tape machines (which are currently a pair of Ampex ATR-124s, but 48-track digital is coming soon to MSA). The room design uses RPG Diffusors custom designed by Peter D'Antonio to produce a very even front end. (See accompanying article by Peter D'Antonio.) Room designers Ben Rizzi and acoustician Charles Bilello (who is an accredited LEDE™ designer by Syn-aud-Con) designed the room with the aid of the Tecron TEF Computer.

The JBL 4435 monitors are mounted above the control room glass with a McIntosh MC 2500 amplifier mounted directly beside each. The amps are strapped for 1000 watts per channel and are connected to the monitors using a short run of Monster Cable. They are isolated from the wall by being mounted on floating mounts to further enhance their sound. The monitors are not aimed down at the console as many studio control rooms are set up. Instead, they are aimed in a horizontal plane toward the rear of the control room. According to Ben Rizzi, this is the proper way to mount the monitors, and upon listening to them, you'll know he's right. Instead of feeling



Studio under construction.

as though the sound is hitting you at high listening levels, you get more of a perception of actually hearing it, as the sound seems to "glide" over you.

The studio features "absolute polarity." Regardless of the amount of signal processing equipment a mic input goes through, a positive wave will be a positive wave from the microphone all the way down to the tape machine. There is also a full pipe grid system in the studio for video lighting to enable any type of live shoots. There will also be an audio post-production suite for video and film as well as SMPTE equipped rooms for computer mixing and video post production.

The studio also features a full array of outboard signal processing equipment including an EMT 251 digital reverb system and a True Star grounding system with all the equipment grounds going to a grounding buss on the console.

MORE ON THE KAUFMAN ASTORIA STUDIOS (KAS)

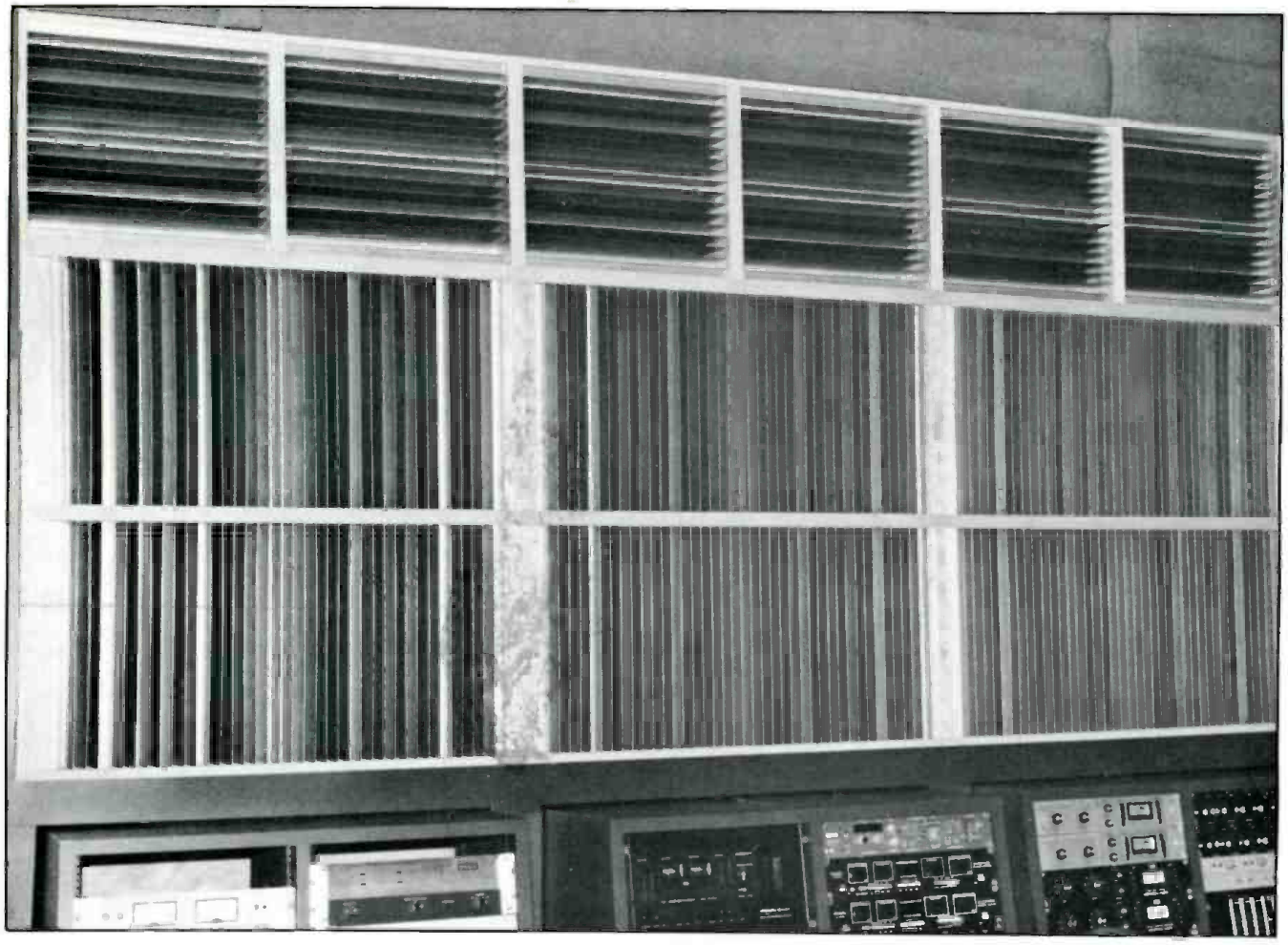
During the start of the American film industry, the complex was Paramount Picture's East Coast Studios. It was originally opened in 1920 and was used to film movies by such stars as Gloria Swanson, Claudette Colbert, W.C. Fields, Rudolph Valentino and the Marx Brothers. Later it was used by the US Signal Corps as the Army Pictorial Center from 1942-1970. After briefly being used by the City University of New York, the buildings were left to decay and be defaced by vandals. Then real estate developer George S. Kaufman put together a financial package to rehabilitate and expand the production facilities. KAS contains the first new sound stages to be built from scratch in over 50 years in the New York area. During the construction of two studios—each 12,000 square feet—500 construction jobs were created to aid the ailing New York unemployment rate. Twenty-three million dollars went into the construction of the new sound stages, a three story support building, and the rehabilitation of the existing sound stages. In addition, extensive support facilities such as production offices, hair and make-up rooms, dressing rooms, wardrobe, carpentry, scenery and prop shops were also rebuilt or built from scratch where necessary.

TAKEOVER FROM THE GOVERNMENT

The original parcel of land was 5.3 acres when it was taken over from the Federal Government by Kaufman in 1977. It has grown to over fourteen acres with more than seventy-five in-house field related tenants. The complex employs about 400 people, but this varies as the jobs go in and out.

Since the complex reopened in 1977, countless feature films and hundreds of commercials have been shot there. The first feature film was "The Wiz" in 1977 and it was followed by a string of movies including "The Warriors."

MSA control room.



RPG Diffusor system in MSA control room.

"Hair," "All That Jazz," "Fort Apache, The Bronx," "Eyewitness," "The World According to Garp," "The Verdict," "The Cotton Club," "Turk 182," and "Death of a Salesman." These were all full budget films, and contributed millions and millions of dollars to a local economy that really needed the boost.

The expansion also includes the addition of two radio stations owned by Doubleday Broadcasting. WHN-AM (the country's number one country station) and WAPP-FM are moving their studios to the complex and are scheduled to begin broadcasting from their spot in the complex—which is adjacent to Master Sound Astoria—by the end of this year. There is already talk of collaboration between MSA and the radio stations for promotions and productions to benefit both.

REHEARSING AT KAS STAGE H

Even without MSA, KAS is a center for music production and rehearsals. In recent months many recording acts have rehearsed at KAS before going on tour. The Beach Boys used the 12,000 square foot stage H before their recent 50-city national tour. They took advantage of the 31-foot grid height to test a unique, new lighting truss design and a new set design for the tour. The Power Station also utilized the stage as a rehearsal studio before their current national tour because they needed a large space with a high power capability. Also using the studio for rehearsal was Roger Waters (lead singer of Pink Floyd) to prepare for his international tour. ■

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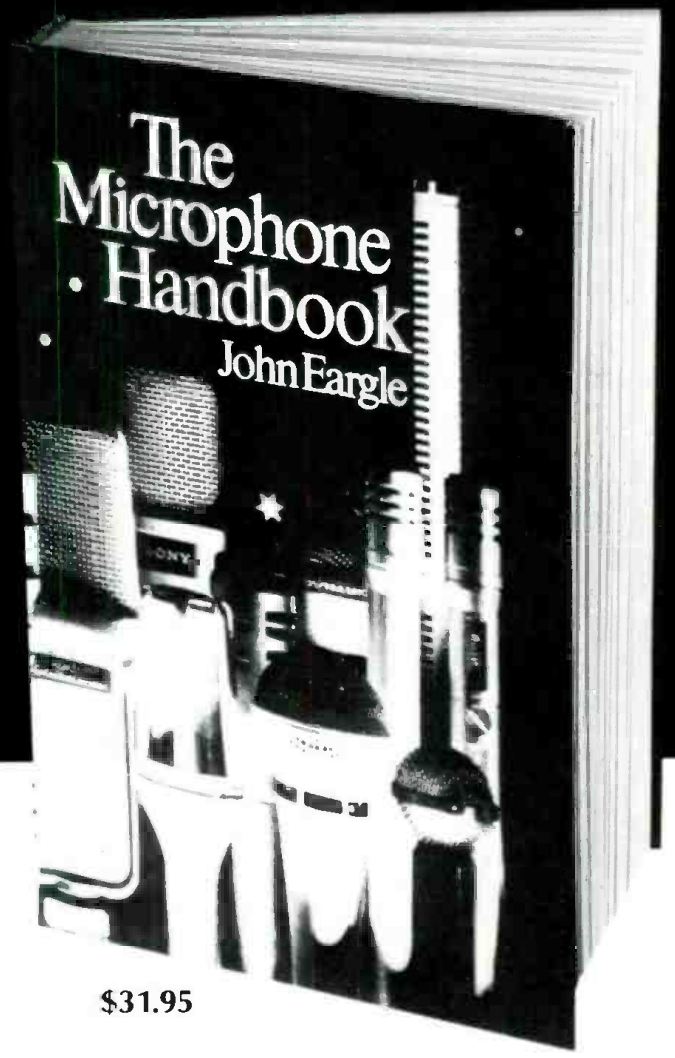

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JOHN EARGLE,
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DR. PETER D'ANTONIO

The Reflection Phase Grating Acoustical Diffusor: Diffuse It Or Lose It

In our article on Master Sound, mention is made of a reflection control system used in the control room. This article details the concepts behind the RPG Diffusor system as used at Master Sound and elsewhere.

ARCHITECTURAL ACOUSTIC DESIGNERS and contractors are called upon to create or modify a wide variety of different listening and performing environments. To achieve the desired acoustical characteristics, designers only have three ingredients at their disposal—namely, absorption, reflection and diffusion. We are all familiar with absorptive materials like fiberglass, foam or diaphramatic panels, which absorb or attenuate sound over a particular frequency range. Reflective surfaces, like flat or curved panels which scatter sound specularly, as light is reflected from a mirror, are also very common. But what are diffusive surfaces, and why are they so important in room acoustics?

Sound diffusion refers to the spatial and temporal distribution of the backscattered acoustical energy from a reflecting surface. A good diffusor distributes this backscattered sound over an appreciable time period (three milliseconds or more) and over a wide angular range. In addition, the energy of the spatially diffused sound (polar energy response) is relatively constant for a broad range of frequencies. Consequently, in evaluating potential sound diffusing surfaces one should consider the steady-state energy response versus time, frequency and directivity, over a broad frequency range. For example, a cylindrical surface provides excellent spatial diffusion, but the temporal distribution is poor and the polar energy response bandwidth is limited. Many surface treatments, such as cylindrical columns, irregular geometrical shapes and distributed absorption, have been utilized to try to improve sound diffusion. While these conventional approaches provide useful scattering, none possesses all of the characteristics necessary for good diffusion.

Research at RPG Diffusor Systems on innovative architectural acoustic products has led to the development of a diffusive surface which offers a unique approach to providing sound diffusion using a reflection phase grating (RPG). The RPG consists of a periodic grouping of an array of wells of equal width but different depths, separated by thin dividers. The depths are based on mathematical number-theory sequences suggested by

Dr. D'Antonio is the president of RPG Diffusor Systems, Inc.

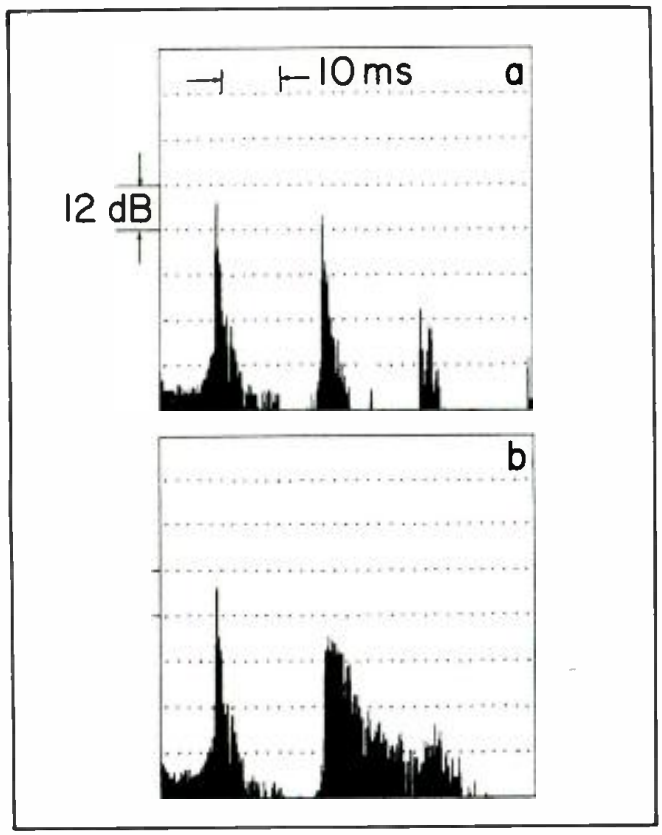

Figure 1. (a) Energy-time curve (ETC) obtained using a boundary measurement technique based on time-delay spectrometry for the backscattered energy from a 4x8-ft. flat panel which was 10-ft. from a pressure-zone measurement microphone and 20-ft. from a sound source. The first peak at approximately 10 ms is the direct sound and the second peak at 30 ms is the reflected sound. (b) ETC for a 4x8-ft. horizontally diffusing QRD cluster in the same geometry. Note the appreciable temporal distribution of the scattered sound.

Manfred Schroeder. The quadratic-residue sequence is one example. A diffusor based on this design is referred to as a QRD. The QRD provides many of the properties of an ideal diffusor, in that the irregular surface provides excellent time distribution and uniform angular coverage over five musical octaves. The backscattered energy versus time for a flat panel (a) is contrasted with that for a QRD (b) in FIGURE 1. Note the appreciable temporal distribution of the backscattered energy for the QRD. The uniform spatial diffusion over five octaves is illustrated by octave-averaged polar patterns in FIGURE 2. This uniform coverage results from the fact that the Fourier transform of the exponientated well depth sequence is a constant. A picture of a QRD cluster can be seen in FIGURE 3.

To fully appreciate the importance of adequate sound diffusion it is helpful to briefly discuss a time-dependent psychoacoustical model of how we binaurally perceive sound in an enclosed space. Sound reaches an observer via direct and indirect reflection paths from surface boundaries. The direct sound is important because it arrives essentially unaffected by the room in which it is generated. The auditory system uses the direct sound to determine source location, spatial textures, timbre and transient response. After an initial time delay, the first reflected sound from the nearest boundary arrives at the observation position. If the boundary surface has very little depth variation, such as a flat wall, a single specular reflection is experienced. If this reflection is strong compared to the direct sound and occurs within approximately 10 ms, it will corrupt spatial textures, cause image shifting and frequency coloration. These very early reflections should be controlled by reflection and/or absorption. If the surface returns energy roughly in the 15-45 ms range and is irregular (containing depth variation as in the QRD), several discrete reflections

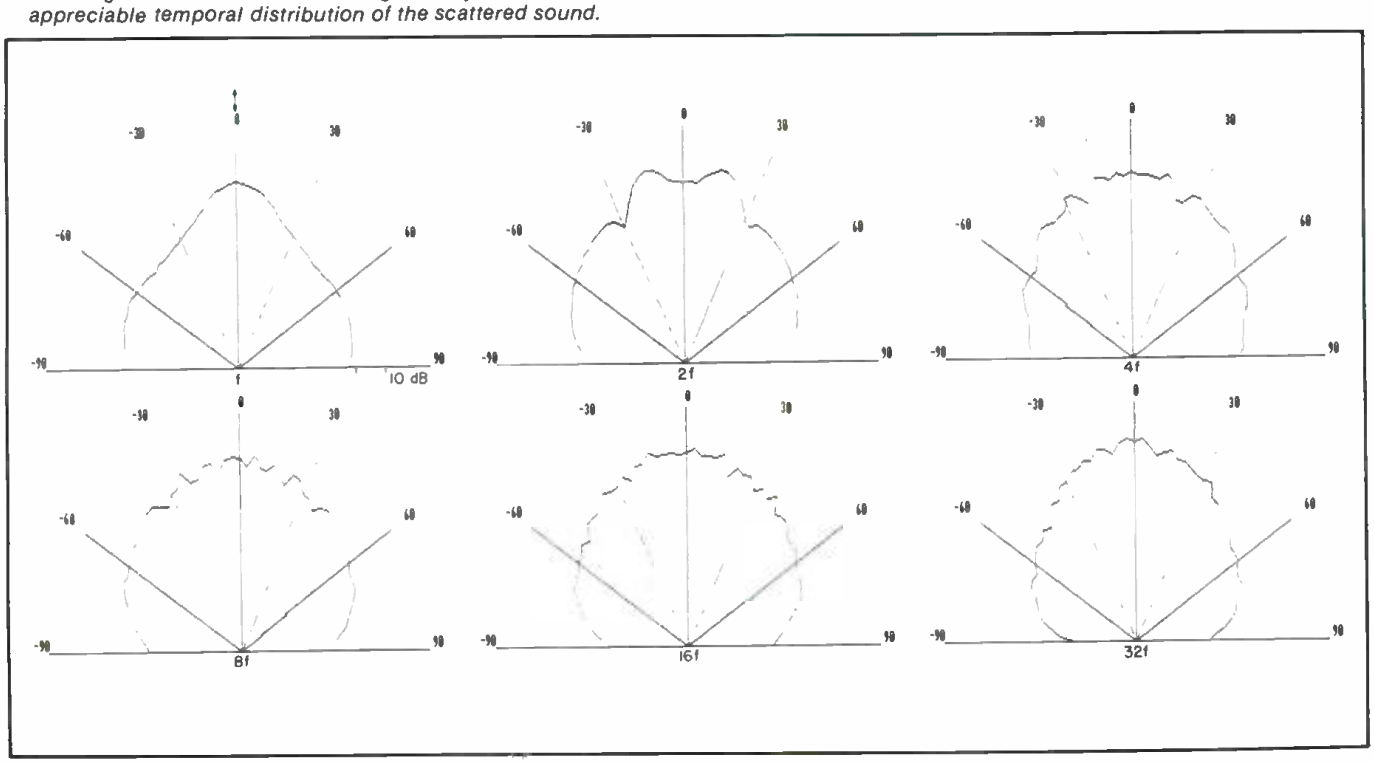

Figure 2. Polar energy response for a QRD. The octave-averaged center frequencies are displayed as multiples of the lowest frequency, f=250 Hz. Note the uniform spatial distribution over five octaves.

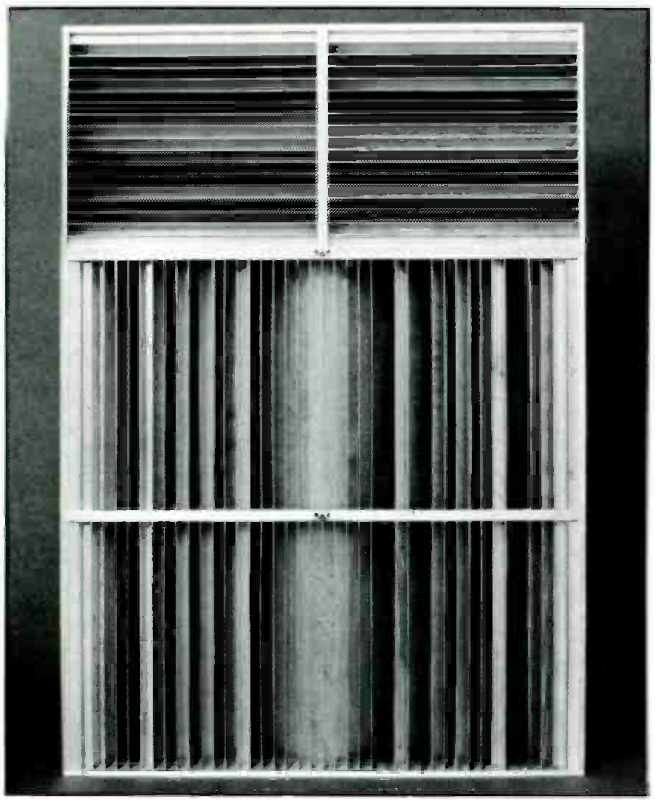

Figure 3. Cluster of two horizontally diffusing (lower units with vertical wells) 24x48x16-in. QRD-4311 units and one vertically diffusing (upper unit with horizontal wells) 24x48x16-in. model QRD-1911.

closely spaced in time will be experienced by the observer, the temporal and spatial diffusion provided by the QRD reduces the steady-state energy, thereby minimizing frequency coloration and false localization. The temporal fusion of the direct and diffuse early sound produces a louder, fuller, clearer and more spatially diffuse sound.

In addition to reverberation and spectral balance, research over the past twenty years has indicated that lateral sound diffusion is a significant parameter which increases listener preference, by decreasing the similarity of sound reaching each ear. This suggests that the directional properties of early reflections as well as their temporal distribution are important in enhancing the spatial impression and stereophonic perception of music. The RPG is uniquely suited to providing this lateral energy. The backscattered sound from a one-dimensional laterally diffusing (vertical wells) RPG is concentrated into a hemidisk whose height is proportional to the projected well length of the modular cluster. This hemidisk can be conveniently directed by orienting the diffusor or the source.

The RPG represents a new architectural acoustic ingredient which was formerly unavailable. Designers and contractors now have at their disposal modular and attractive room treatment which is easy to install, has been proven effective and is readily available in almost any natural wood or laminate finish. The RPG can be used to enhance the acoustics of any critical listening or performing environment.

Figure 4. Rear view of control room at Teleimage, Dallas, TX.

The RPG is finding widespread application in control monitoring rooms for audio, radio, stereo TV, audio-for-video, film and editing. The accurate perception of spatial textures over loudspeakers in listening environments ranging from control rooms to the home is becoming increasingly important with the advent of stereo TV, Ambisonics, Holophonics and Spatial Reverberation. Psychoacoustical experiments using the Listening Environment Diagnostic Recording, developed by Douglas Jones, have demonstrated the importance of sound diffusion and the control of very early reflections. A new design for a reference monitoring room has been developed at RPG Diffusor Systems for the faithful perception of spatial textures, and the accurate evaluation of frequency balance, signal processing and reverberation. This design incorporates a reflection-free zone, RFZ, in the front of the room, which minimizes the speaker-boundary-interference over a large volume including the entire console and mix position, and RPG diffusors in the rear of the room, to provide a dense diffuse lateral sound field, which permits critical listening anywhere in the rear of the room. The RFZ/RPG design has been utilized in many new installations including Teleimage, Dallas, TX, designed by Russell E. Berger of Joiner-Pelton-Rose (FIGURE 4) and Master Sound Astoria, Astoria, NY, designed by Charles Bilello (cover photo).

The need for effective diffusion in recording studios is becoming increasingly more important with the use of digital recording. We are presently enjoying a renaissance in studios with good natural acoustics. The RPG can be used in ceilings and/or walls or as moveable partitions to provide variable early energy to complement variable reverberation designs. The RPG can be used to increase the apparent size of small rooms and hence can be effectively utilized in mobile studios and voiceover/announce booths.

The RPG can be employed in auditoriums, churches, performing arts facilities, theatres and rehearsal spaces as modular suspended ceiling panels and/or wall systems to provide significant early lateral energy and control slap and flutter echoes, without introducing absorption. Listeners in the audience benefit from more uniform coverage and an enhanced stereophonic experience, with precise imaging, spatial textures and "clarity." The RPG has also been used as an orchestral/choir shell to provide the necessary early reflection pattern which afford a heightened sense of ensemble for performers. Low cost RPG licensed concrete wall forming can significantly reduce the cost of indoor and outdoor venues.

Since quality and intelligibility are becoming important in business conference rooms and audio/visual multi-purpose rooms. The RPG can also be used in conjunction with PA systems in clubs to assist in providing uniform coverage and minimizing room interference.

The RPG is finding extensive application in the audio industry. These are a few installations using the systems:

Acorn Sound Recorders—Oak Ridge Boys, Hendersonville, TN;
Chicago Recording Company, Chicago, IL;
Mastermix, Nashville, TN;
Master Sound Astoria, Astoria, NY;
Medallion Film Labs, Toronto, Canada;
NBC, Burbank, CA and Brooklyn, NY;
New Age Sight & Sound, Atlanta, GA;
Otis Conner Productions, Dallas, TX;
Polygram, New York, NY;
RCA, New York, NY;
Jimmy Swaggart Ministries, Baton Rouge, LA;
Streeterville Studios, Chicago, IL;
Teleimage, Dallas, TX;
TRC, Indianapolis, IN;
WFMT Radio, Chicago, IL.

For more information contact RPG Diffusor Systems, Inc., 12003 Wimbleton Street, Largo, MD 20772; (301)-249-5647.

™RPG, QRD and RFZ are trademarks of RPG Diffusor Systems, Inc. ■

REFERENCES

1. P. D'Antonio and J. H. Konnert, "The Reflection Phase Grating Diffusor: Design Theory and Application," J. Audio Eng. Soc., Vol. 32, No. 4, pp. 228-238 (April 1984).
2. Synergetic Audio Concepts Tech Topics, Vol. 11, No. 7 (Spring 1984).
3. Synergetic Audio Concepts Newsletter, Vol. 11, No. 32, pp. 14-17 (Winter 1984).
4. P. D'Antonio and J. Konnert, "The RPG Reflection Phase Grating Diffusor," Mix Magazine, Vol. 8, No. 8, pp. 74-76 (August 1984).
5. P. D'Antonio, J.H. Konnert and F. Becker, "The RPG Reflection Phase Grating Diffusors: Experimental Measurements," 76th AES Convention, New York (October 1984), Preprint No. 2158.
6. P. D'Antonio and J. H. Konnert, "The RPG Reflection Phase Grating Acoustical Diffusor: Applications," 76th AES Convention, New York (October 1984). Preprint No. 2156.
7. P. D'Antonio and J.H. Konnert, "The RFZ/RPG Approach To Control Room Monitoring," 76th AES Convention, New York (October 1984), Preprint No. 2157.
8. Synergetic Audio Concepts Tech Topics, Vol. 12, No. 1 (Fall 1984).
9. R. Todrank, "Incorporating Reflection Phase Grating Diffusors on the Rear Wall to Enhance Spatial Imaging and Stereo Ambience," Recording Engineer/Producer, Vol. 15, No. 6, pp. 122-125 (December 1984).
10. P. D'Antonio and J.H. Konnert, "The Role of Reflection Phase Grating Diffusors in Critical Listening and Performing Environments," 78th AES Convention, Anaheim (May 1985). Preprint No. 2255.
11. P. D'Antonio, John Konnert and Russell E. Berger, "Control Room Design Utilizing a Reflection Free Zone and Reflection Phase Grating Diffusors: A Case Study," 78th AES Convention, Anaheim (May 1985).
12. B. Comer, Mix Magazine, Vol. 9, No. 5, pp. 126-130 (May 1985).
13. J. McCarthy, Mix Magazine, Vol. 9, No. 8, pp. 20-25 (August 1985).
14. P. D'Antonio, "The Reflection Phase Grating Acoustical Diffusor," Innovations in Sound, Pro Sound News (September 1985).
15. M.R. Schroeder, "Number Theory in Science and Communication, with Applications in Cryptography, Physics, Digital Information and Self-Similarity," Springer, New York, 1985.
16. M.R. Schroeder, "Progress in Architectural Acoustics and Artificial Reverberation: Concert Hall Acoustics and Number Theory," J. Audio Eng. Soc., Vol. 32, No. 4, pp. 194-203 (April 1984).

WANTED

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BOURBAKI WONDER SOFTWARE

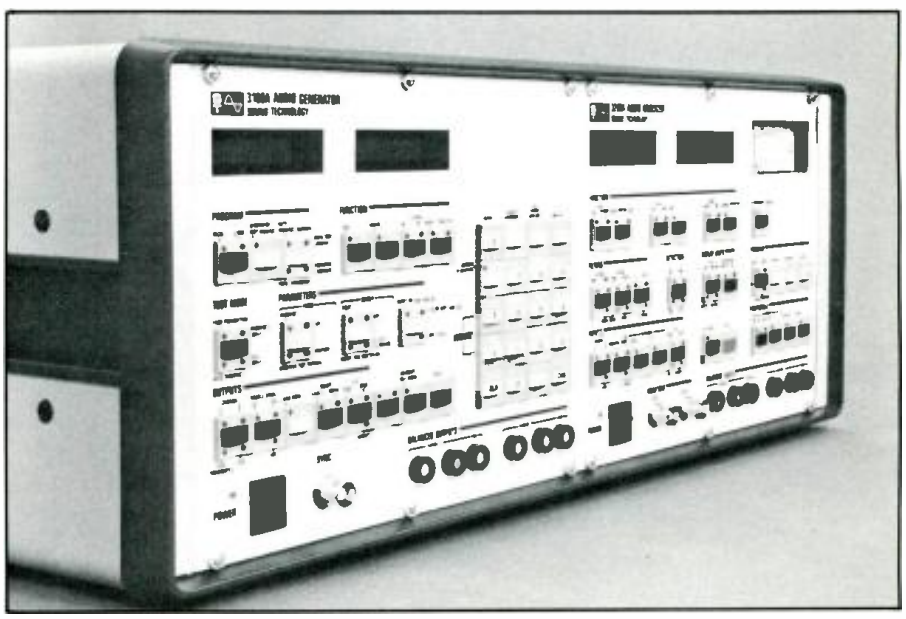
• Bourbaki Inc. may be a new name to audio pros, but if you, like us, are using computers (especially IBM PCs and compatibles) then this may well be a company you ought to know. Those of us that have wrestled with the stubbornness of MS-DOS and our inability to do much with it except copy or format diskettes, will welcome an exceptional program called simply 1 dir (WONDER). What this program does is take the MS-DOS directory and envelope it in an attractive (and colorful if you have a color monitor) display. Once so enveloped, the program permits you to copy, delete, change names, and dozens of other things to files, with an ease that you won't believe until you have the program. You may need to partly strip down your MS-DOS disk to its essentials for boot-up, before you install 1 dir. It requires a great deal of disk space if you want the entire program with its help routines, or you can get the basic program onto disk with only about 60k used. However, once it is booted up and running, you can take out the diskette and substitute any others, since 1 dr entirely resides in RAM while the computer is on.

Mfr: Bourbaki, Inc.
Price: $95. for IBM compatible disk with manual.

Circle 9 on Reader Service Card

SOUND TECHNOLOGY AUDIO TEST EQUIPMENT

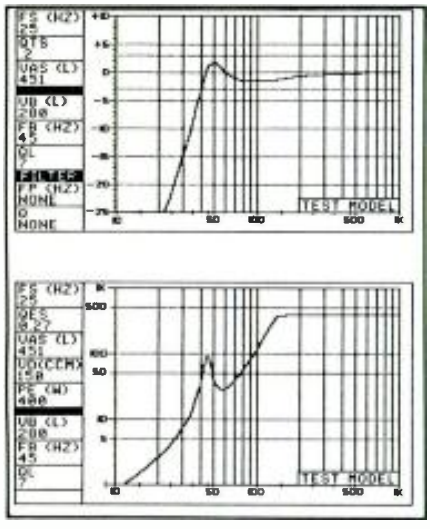
• The Sound Technology 3000 Series audio and transmission test system is designed for benchtop, field service, production line and remote testing. The 3000 Series consists of two separate components: the 3100A Generator and the 3200A Analyzer. Both microprocessor-based instruments feature front panel programmability which allows storage of extensive automated test sequences. Both also feature the ability to communicate test data through the audio line being tested because of an exclusive Frequency Shift Key (FSK) technique. This feature allows unmanned, automated remote transmission line testing (such as proof-of-performances for microwave, satellite, or telephone lines) without the need for external computers and modems. Test results are achieved in less than sixty seconds and may be graphed on a standard printer or plotter. If desired, the 3000 Series functions may also be controlled via RS-232C or GPIB (IEEE-488) communications ports. The two-channel, electronically-balanced and floating 3100A Generator outputs sinewaves, squarewaves, IMD, toneburst and sinestep waveforms. The two-channel companion 3200A Analyzer will measure level, noise, frequency, harmonic distortion, intermodulation distortion, phase error, channel separation and quantizing noise (digital data). Output levels range from +30 to -90 dBm; system residual distortion is less than 0.001%; measurement speed is 500 milliseconds for distortion and 150 milliseconds for level above 50 Hz. Both components have extensive RF shielding (utilizing fiber-optic technology) and are available as separately housed portable instruments or in a single rack mounting or stand-alone chassis.



Mfr: Sound Technology
Price: 3000A (Single Mainframe)—$8,950;
3100A Audio Generator—3,950;
3200A Audio Analyzer—5,350.

Circle 29 on Reader Service Card

SPEAKER DESIGN SOFTWARE

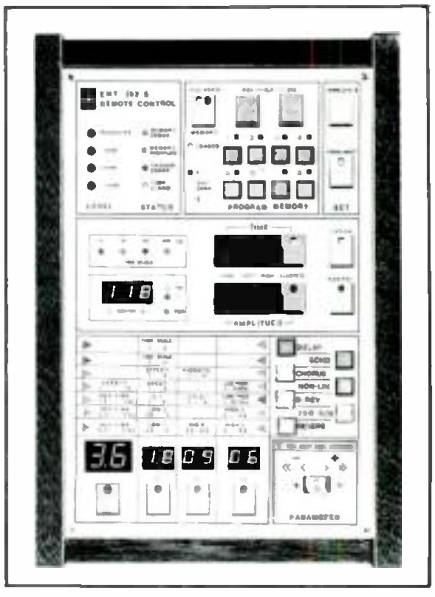


• Computer-Aided Speaker Design was developed for anyone who designs loudspeaker systems, and is a necessary tool for contractors, sound companies, consultants and manufacturers. This package allows complete modelling of loudspeaker systems and accurately predicts system response before any prototypes are built. Version 2.0 comes as a two-disk set. Besides the main program disk, a file disk allows data storage on up to 800 speaker drivers and is shipped loaded with data on over 120 drivers from various manufacturers. The program calculates and graphically plots the response and displacement limited functions for both sealed and vented systems. The inclusion of an electronic filter can be incorporated in the design chain as well. The user has full control over graph scales and resolution. A complete crossover design program allows 6, 12, 18, and 24 dB/octave crossovers to be designed complete with impedance correction circuits. Nine utility programs calculate various often used functions including reference efficiency from Thiele/Small parameters, vent tunings, passive radiator mass, etc. A file maintenance program allows updating of driver files and allows driver sorting and selection by user specified driver parameters. Each driver has 14 stored parameters to permit complete system analysis. Computer requirements are: An Apple II computer with 64K memory, Applesoft ROM and two disk drives. The Grappler parallel printer interface is supported for graphic screen print-outs. An IBM version is presently in development. Computer-Aided Speaker Design comes complete with a 90 page user's manual.
Mfr: Scientific Design Software
Price: $99.95.

Circle 30 on Reader Service Card

EMT DIGITAL REVERBERATION SYSTEM

• The EMT 252 Digital Reverberation System is the latest development from EMT. The system provides very natural reverberation through digital processing using high-resolution 16-bit analog/digital conversions and 32 kHz sampling. In addition to generating excellent reverberation effects, the EMT unit provides three delay-based effects: straight delay, loop echo and chorusing effects. The reverberation program provides up to nine individual reflections before reverberant signal, time and amplitude of the reflections are adjustable individually, with frequency response of the system adjustable in four separate bands. Reverberation is generated using the entire audio frequency range of the source signal, resulting in very natural sounding output. Four reverberation algorithms are implemented in the EMT 252: the main reverberation program, the reduced bandwidth (EMT 250) program, the Doppler-shifted program and the non-linear decay program. One of these four programs can be selected on the basis of the audio program material content and the reverberation characteristics desired. In addition to the four reverberation programs, three delay-based effects are available: delay, echo and chorus. The delay mode provides up to 480 ms delay for three individual taps in fixed relation to one another. Echo mode provides four "loops" of up to 440 ms delay with feedback amplitude adjustable on each. The chorus mode provides up to four voices from one input source with control of depth and rate of the chorus effect. All settings for the effects programs provide the full bandwidth in conversion and processing, yielding excellent frequency response and stereo effects at all times. The EMT 252 system is physically housed in a 19-in. rack mounting enclosure with control of all functions and display at all settings appearing on a separate 8-in. x 12-in. console. This console is connected by a single balanced audio line to the main rack enclosure and can be remotely placed at distances greater than one hundred meters. This feature permits the main electronics to be kept in a central location and the control console to be connected via one additional audio tie-line wherever control of the reverberation system is requited. The console provides 128 memory presets for each of the reverberation and effects programs: half are preset at the factory and half are programmable by the user. The console stores the presets in battery-backed memory: 16 fixed and 16 user presets for the main reverberation program and 8 fixed and 8 user presets for each of the six other reverberation and effects programs. Single button recall of random or sequential presets is provided as well as means to copy settings from one preset to another with desired modifications. Factory fixed settings can be converted to user-modifiable settings optionally allowing all 128 memory locations for user presets.
Mfr: EMT
Price: $16,500.



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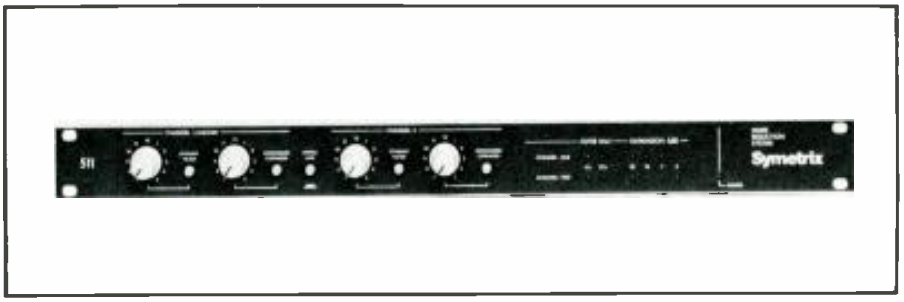
SYMETRIC NOISE REDUCTION SYSTEM



• Symetrix, Inc.'s model 511A is a "non-complementary" system which means noise reduction is accomplished without traditional encode-decode processing. The obvious advantage is that the Symetrix unit may be used to remove existing noise from recorded tapes or for that matter from virtually any noisy audio source including mixing consoles, effects and processing devices, etc. The 511A is useful for recording and broadcast studios, video post production, video and audio tape duplication facilities, and touring sound reinforcement companies. In operation the 511A works to eliminate noise by processing the incoming signal with a voltage-controlled dynamic filter in series with a "soft-knee" downward expander. The user may select either circuit independently or use both at once. The newly revised 511A provides independent variable threshold controls for both the expander and filter circuits as well as independent in/out switches for each circuit. The two channels of the 511A may be used either as independent mono channels or linked together in the stereo mode so that exactly equal amounts of noise reduction occur in both channels. The 511A is packaged in a convenient single-space rack chassis. Electronically balanced inputs and outputs are provided in addition to standard unbalanced inputs and outputs.

Mfr: Symetrix, Inc.
Price: $595.

Circle 32 on Reader Service Card

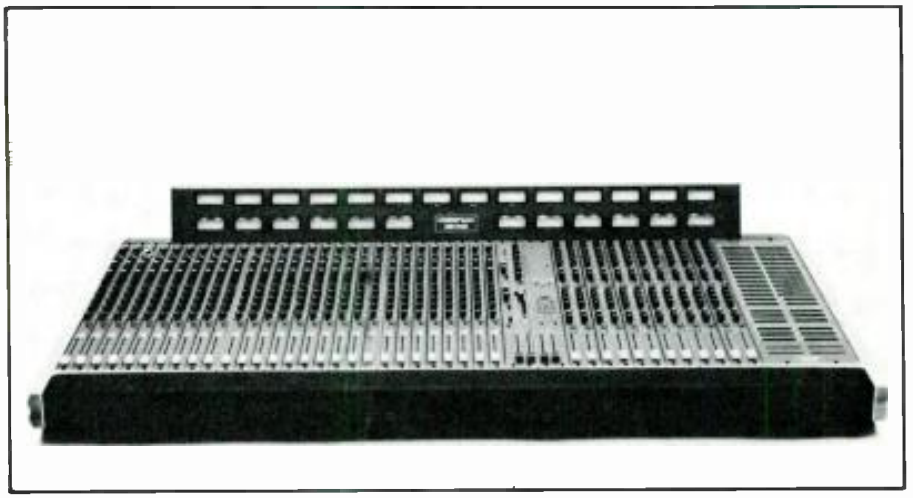
SEQUENTIAL DIGITAL SAMPLING KEYBOARD

• The Prophet 2000 is an eight-voice sampling instrument featuring a weighted action velocity-sensing keyboard. It combines high resolution digital sampling technology with extensive enhancements. For instance, a user can sample any sound using features which include a variable input level control, complex sample editing (reverse, mix, truncate), and automated looping functions such as computer assisted zero cross-over and zero slope selection to help find the best possible loop points. A built-in 3½-inch disk drive provides for fast and easy storage of custom sounds and programs. A large selection of recorded sounds are available for Sequential's library of factory disks. The Prophet 2000 has multiple wavetables stored in on-board memory for building "traditional" synthesizer sounds. These sounds can be played alone or in conjunction with sampled sounds by splitting the keyboard or layering sounds on top of each other. The Prophet 2000's velocity-sensing 5-octave keyboard provides precise control over loudness, modulation amount, timbre, sample start points and crossfading between two separate sounds. Its weighted action responds positively to every nuance of the player's individual technique. The keyboard can be split, with different sounds assigned to each half, or with multiple sounds layered on top of each other. The player can utilize various controls provided and create as many as 12 keyboard combinations, with instant access of up to 16 sound variations. The Prophet 2000 also features pitch and programmable modulation wheels, as well as very impressive arpeggiation capabilities including programmable up, down, assign, extend, auto-latch, and transpose modes. A thorough MIDI implementation includes full support of modes 1 (poly) and 3 (omni), receivable in mode 4 (mono), clock-in and out, pitch and modulation wheels, main volume, switchable MIDI-THRU and 2nd MIDI-OUT, complete wavetable access/programming via an external computer, and the ability to transmit and receive sound samples over MIDI. The Prophet 2000 is based on 12-bit digital technology. Samples with a duration of 16-seconds have a bandwidth of 8 kHz, with 8-seconds having 15 kHz, and 6-seconds having 20 kHz. The user may sample at rates of 15.625 kHz, 31.250 kHz, and 41.667 kHz. The disk drive uses standard 3½-inch diskettes. No special preformatted diskettes are required. Each voice in the Prophet 2000 features a 4-pole low pass VCF, a VCA, velocity controlled four stage envelopes, plus access to the unit's on-board waveshapes. Any sampled sound can be modified using these analog controls, as well as additional digital and keyboard controls provided. By assigning two or more samples to the same keyboard range, layered sounds and multiple-voice stacks may be created. Up to 16 samples can be assigned anywhere on the keyboard.

Mfr: Sequential
Price: $2,499.

Circle 33 on Reader Service Card

SOUNDTRACS MIXING CONSOLE

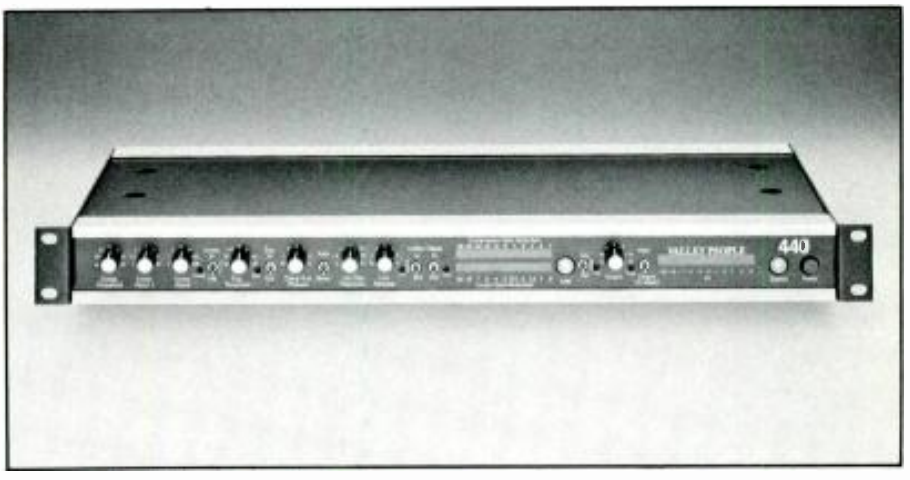


• Soundtracs' microprocessor based CM 4400 modular mixing console offers innovative applications of micro-processing that has permitted Soundtracs to develop a truly software flexible mixing console at an affordable price. An ingenious single button routing system permits all input and output modules to be identical in hardware construction. The result is that there are only two kinds of modules, input and output, and they are the same regardless of the number of busses, only the software changes. This permits an incredible savings in manufacturing and tooling costs which in turn are passed on to the customer. An RS-232 port has been added allowing the CM 4400 to communicate with any PC which has an asynchronous input. By writing software which allows you to preprogram the track sheet, each memory position can be shown on the terminal as functions, not numbers. Software updates are now being explored to enable the mixer RAM to be externally steered by a SMPTE clock or track. The board is transformerless and all inputs are electronically balanced. Output transformers are optional as well as P & G faders. The board uses 5532, 5534, and TLO series chips, and discreet mic-pre with IC buffer. The slew rate is very high 10V per microsecond to eliminate group delays.

Mfr: Soundtracs, Inc.
Price: Approx. $20,000.

Circle 34 on Reader Service Card

VALLEY PEOPLE LIMITER/ COMPRESSOR/DYNAMIC SIBILANCE PROCESSOR



• The Model 440 is a single channel device offering the convenience of a peak limiter, a high quality compressor/expander package, and a Dynamic Sibilance Processor section, each controlling a common VCA. Sophisticated intercoupling of the control circuitry used for each function allows the device to simultaneously limit, compress, expand, and eliminate high frequency components in sibilance. Model 440's compressor control section features continuously adjustable threshold, attack time, ratio and release time. In addition, an interactive expander control is integrated with the compressor control circuitry to reduce residual noise which would otherwise be "pumped up" or accentuated by the compression process. Special release coupling makes the transition from compression to expansion imperceptible, thus eliminating problems associated with the use of separate single-function units. The limiter control section exhibits extremely fast attack characteristics, typically 1 microsecond/dB or less, continously variable threshold, a fixed 60:1 ratio, and variable release time. Using special control intercoupling, the device operates as compressor following a fast peak limiter. The compressor's Gain Recovery Computation circuitry maintains a preset nominal output level under varying conditions of input level, ratio and threshold settings. In critical applications, the limiter may be linked with a safety clipper. The clipper threshold automatically tracks that of the limiter control section in order to eliminate any extremely fast transients which might escape the limiter. In the auto mode, the compressor attack time, ratio, and release time are optimized for one-control operation. With the sophisticated control circuitry of the auto mode engaged, the operator is allowed to obtain more or less compression by simply adjusting the threshold control. The proprietary circuitry of the Dynamic Sibilance Processor analyzes the sibilant waveform, in order to detect and cancel only the coherent and objectionable portions of the sibilant sound, such as whistles. By cancelling these components instead of equalizing the signal chain, the DSP does not color or affect the tonal balance of the accompanying mixed program material. Barrier strip connectors are provided for all inputs and outputs. Electronically balanced inputs and outputs are also standard.

Mfr: Valley People, Inc.
Price: $599.

Circle 35 on Reader Service Card

• **Robert C. Majernik** has recently been promoted to vice president and treasurer of **AKG Acoustics, Inc.**, in Stamford, Connecticut. He has been employed by AKG for the past six years, serving in the capacity of controller. Once a divisional operation of North American Philips Corporation, AKG Acoustics began independent distribution and service of all AKG products sold in the US. In recent years, the product line has been expanded to include quality audio products for the consumer. Majernik's previous work experiences have all been in the general accounting field with broad exposure in accounting and data processing functions, budget and business analysis, automated inventory control, and tax preparation... **David Talbot** has been promoted to the position of sales manager of Professional Products for AKG Acoustics, Inc. Talbot is expected to continue with customer application training as well as dealer relations in coordination with AKG rep organizations. Talbot's experiences have been spread throughout the audio business, and range from consumer sales, audio and broadcast engineering, clinics and seminars to systems design, setup and analysis. In his new capacity, his efforts will be concentrated on the music and recording industries... **Richard Ravich** has been promoted to the post of vice president and general manager of AKG Acoustics, Inc. Prior to this promotion, Ravich served as vice president of marketing. Previously, AKG was a division of North American Philips Corporation, New York, through which AKG manufactured products were distributed. As of January 1985, AKG began independent operations and maintains its own distribution network in the US. AKG products and distribution are not new to Ravich. He has been associated with the company as a top marketing executive for the past eleven years during which his expertise has had marked influence on marketing, production management, sales management, advertising and administration. Previous work experiences were all audio associated. He was previously assistant national sales manager for Stanton Magnetics, Inc., where he got first-hand exposure to both the dealer and distribution mechanics of the trade. Earlier, he worked in the Corporate Planning Department of the National Broadcasting Company. AKG Acoustics manufactures and markets dynamic and condenser microphones, microphone stands and accessories, reverberation units, digital delay lines, phonocartridges, and Cecil Watts record care products.

• **Digital Entertainment Corporation**, a subsidiary of Mitsubishi Electric Sales America, Inc., is pleased to announce the appointment of **Adrian Bailey** as manager of the Pro Audio Group's United Kingdom operations. Bailey will be based at Quad Eight/Westrex Ltd., a subsidiary company of DEC, located at Greenford, Middlesex. Bailey joins DEC following a successful career at Neve International, one of the leading manufacturers of recording consoles. At Neve he held several management positions in manufacturing, technical services and recently turnkey contracts. He was responsible for negotiating many large contracts in the UK and Western Europe and their subsequent supply and installation. The Pro Audio Group's operations in the UK involves the manufacture of Westrex Film Sound Recording Systems at the Greenford plant and a sales team covering markets in the UK, Europe, Middle East and Indian Sub Continent for Quad Eight, Westrex and Mitsubishi recording products. Technical Field Services will be based at Greenford. Bailey's technical knowledge and extensive experience of the Pro Audio Market will greatly strengthen the growth of DEC operations in the UK and world markets.

• **Michael J. Feniello** has been named national product manager for Sony Professional Audio Division. His responsibilities include product and market analysis, product training and trade show support. Feniello comes to Sony from Valley Audio in Tennessee where he held positions in sales and marketing. His background also includes positions in audio engineering and tour management.

• **Earl D. Harris Jr.** has been named director of engineering for **Electro-Voice, Inc.**, a supplier of high-technology microphones, speakers and electronics to professional and consumer markets worldwide. Harris reports to president Robert D. Pabst and is responsible for administering E-V's microphone, loudspeaker, electronics, military and aviation engineering division. As director of engineering, Earl Harris is responsible for the manner in which E-V engineering interfaces with the needs of the company. By structuring engineering operations to be responsive to those needs, Harris will play an essential part in E-V's evolution to a market-driven organization. Harris comes to E-V from Ehrhorn Technological Operations (Canon City, CO), a manufacturer of power amplifiers for the medical industry, where he organized and administered engineering and quality assurance and aided in setup and support of manufacturing operations. Prior to that Harris served as chief engineer of technical products at the Heath Company (St. Joseph, MI).

MIAMI'S "NEW CRITERIA"

• Major renovation at **Criteria Recording Studios** includes the acquisition of two Solid State Logic SL6000E 48 input consoles with Total Recall and a Mitsubishi X-800 32-channel digital multitrack recorder. Studio president and longtime industry pioneer Mack Emerman announced the "New Criteria" at the studio's thirtieth anniversary celebration amid a flurry of recording activity by a number of new artists at the Criteria Complex. The equipment package will be installed in Criteria's new east wing, which was designed by John Storyk of Sugarloaf View, in conjunction with Emerman and the studio's staff. The popular Studio E becomes Studio A and along with the SSL console and twenty-seven foot high ceiling includes some exciting new acoustical updates as well. Emerman designed two "Acousto-Wings" measuring five by fifteen feet which will be mounted one above the other on the studio wall at a level of twelve and eighteen feet. Each contains a pair of flush-mounted PZM microphones and have the ability to be electrically adjusted to any angle, thus creating an exciting new acoustical tool. Studio B formerly housed the studio's mastering operations and its location directly upstairs from Studio A makes it an ideal home for the second SSL console. The new control room is identical to Studio A's having the same dimensions, acoustical treatment and special monitors custom designed for Criteria. A generously sized overdub room adjacent to the control room opens up to a live echo chamber. The new Mitsubishi X-800 digital multitrack is installed in a sound lock adjacent to Studio A, but will be used in both rooms. Tie lines and television monitors have been installed to keep the digital operation flexible. Studio C will also see significant acoustical upgrades with the addition of the specially designed monitors and a new hardwood floor designed to make the room more "live." A second isolation booth will be added along with some new cosmetic treatments and all three rooms will also house analog multitrack recorders. The Criteria Cutting Center will be housed directly across the hall from Studio B and is said to be the premiere state-of-the-art mastering facility in the Southeast. Using Ortofon 731 and 732 cutter heads aboard a Scully 1576 Lathe in conjunction with a Cybersonics Automated Console, the new facility will be manned by Senior Engineer Michael Fuller. Fuller has become a major force in the mastering business of late, with album work by Kenny Rogers, the BeeGees, Rod Stewart, the Romantics, Kenny Loggins, Barry Manilow, Julio Iglesias, Dionne Warwick, etc., under his belt. In addition, the Sontec MES430B equalizer and DRC400 limiter system will be used for finishing touches. The room also includes two Mitsubishi X-80 Series digital master recorders along with ¼- and ½-inch analog decks. Fuller will also be offering a new range of CD mastering in the new facility. Criteria will also be adding a real-time cassette duplicating suite, enabling the studio to offer the highest possible quality cassettes produced from a variety of digital or analog sources. For further information about Criteria Recording Studios contact Mack Emerman: Criteria Recording Corp., 1755 NE 149th St., Miami, FL 33181; (305) 947-5611.

GROG KILL UPGRADE

• **Grog Kill Studios** of Willow, New York, has recently completed a major upgrade of their studio facilities. In addition to expanding the control room, Grog Kill has installed a new 36-input Harrison Raven console fitted with Audio Kinetics' Master Mix disc-based mixdown automation. Two new Otari tape machines were also installed—an MTR-90 MkII multitrack and an MTR-12 MkII two-track for ¼-in. or ½-in. mastering. Dolby noise reduction is available for both machines. The expanded control room houses UREI 813Bs as the primary monitors with Westlakes, Visoniks and Auratones available as alternate. Lexicon 224XL and AMS RMS-16 digital reverbs were purchased to complement the studio's EMT 240 gold foil reverb. Other new outboard equipment includes a Lexicon 95 DDL, an AMS DMX-15-80X DDL/pitch changer/digital sampler and noise gates and a stereo compressor/limiter by Drawmer.

DIGITAL TAPE FORMAT STANDARDIZED

• The fundamental parameters for the first standardized broadcast-quality digital video tape recording format were approved by the **SMPTE Working Group** of Digital Television Tape Recording. The group met in New York and agreed to submit to formal ballot a series of draft SMPTE standards. Because of close cooperation with the European Broadcasting Union (EBU), the new format represents a worldwide consensus, and

newly approved draft EBU specifications are essentially identical to the draft SMPTE standards. The new SMPTE format is named Type D-1. It defines a component digital television recording system that will produce high quality recordings of 525-line digital video signals conforming to CCIR Recommendation 601. The advantages of the digital recording format include essentially perfect recording and playback through ten to twenty generations, four high quality digital audio channels, and production versatility comparable to that of the widely used SMPTE Type C analog recording format. This important milestone was reached after several years of discussion by an earlier SMPTE Study Group and follows eighteen months of intense activity by the WG-DTTR itself. The start of the balloting process represents agreement by the WG-DTTR members that the Working Group objectives had been met. The balloting process follows the standardization procedures of the SMPTE and of the American National Standard Institute (ANSI). The new SMPTE draft standards specify the dimensions of the magnetic patterns recorded to tape, the characteristics of the magnetic tape itself, the design of the cassette in which the tape is housed, the electrical characteristics of the digital audio and video signals placed on the tape, and specifications for control-track and time code recordings. The new format is unique in two respects. First, Type D-1 mechanisms and signal processing systems can be used worldwide for any digital television signals that conform to CCIR Rec. 601. Second, the designer of a D-1 tape transport mechanism can use one of several different combinations of tape scanner diameters and data head arrangements. The format allows different design choices to be made for different applications. Testing of recordings made according to the draft D-1 standards, necessary to prove satisfactory recording interchange, will begin under WG-DTTR auspices after the several participating manufacturers have completed their prototype machines. This evaluation process will begin in 1986. Production equipment is expected in 1987.

EVERGREEN UPDATES MONITORS

• Award winning **Evergreen Studios** has replaced the drivers in their three monitors in Studio A with Cetec Gauss components—Model 3588 15-in. coaxials and 4583 15-in. woofers. The drivers were originally replaced as a test, according to Evergreen's Head of Engineering Marc Gebauer. "We figured if the Gauss components sounded good in those cabinets, they had to be better," Gebauer explained, "and, they sounded better than anyone imagined." "We've gotten nothing but compliments. The top is much smoother. They're tighter on the bottom, and when audio consultant George Augspurger re-tuned the room, the room EQ controls were virtually flat," he continued. Evergreen is now designing their own cabinets for the Gauss loudspeakers which will be bi-amped. Because of the success of the sound in Studio A, Evergreen will also replace their three monitors in Studio B with Gauss components and custom cabinets.

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